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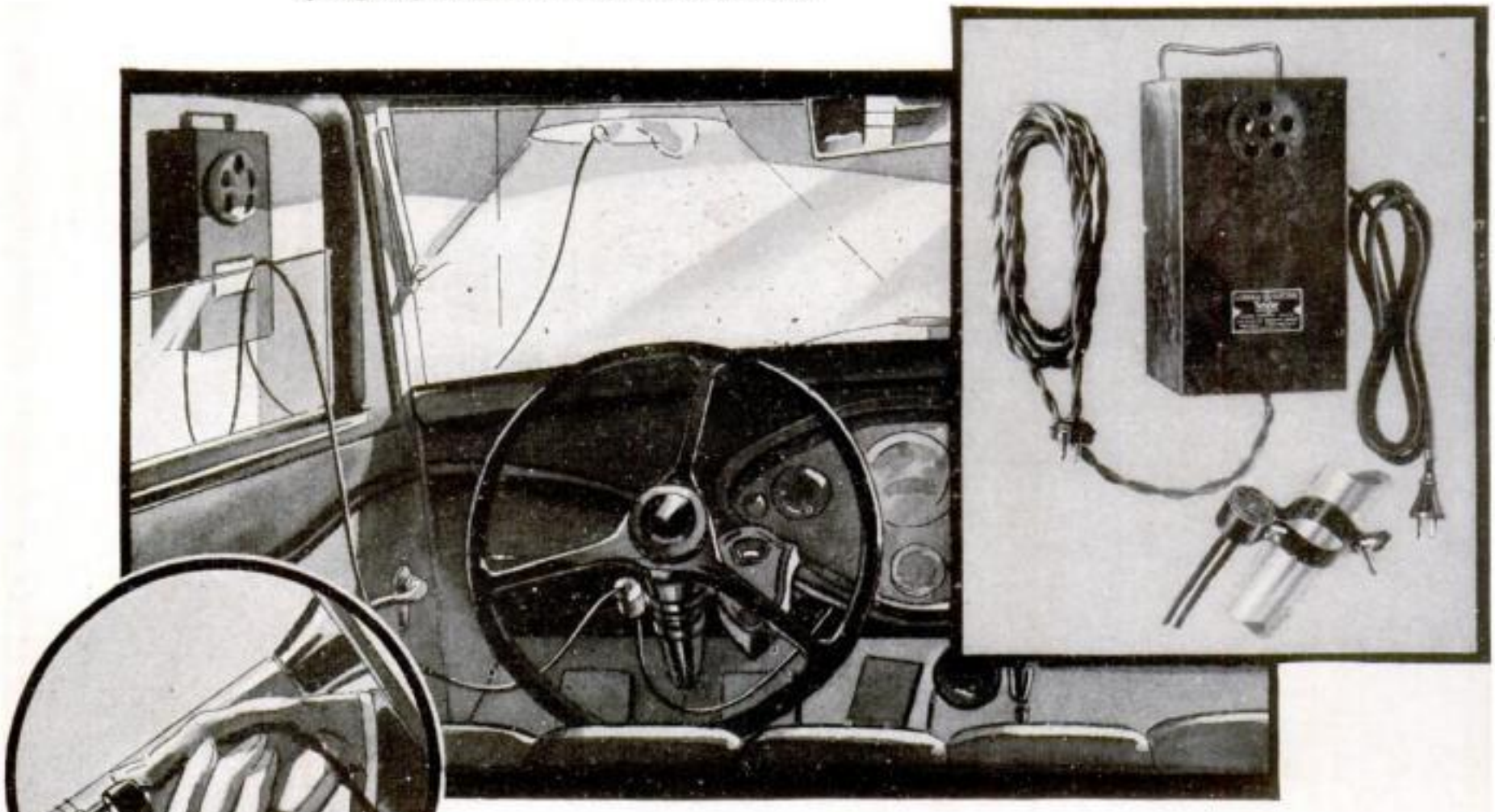

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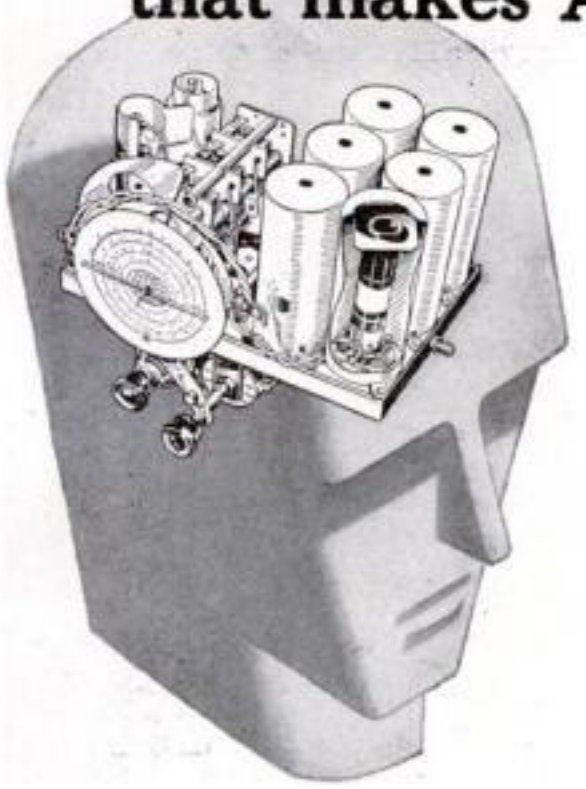

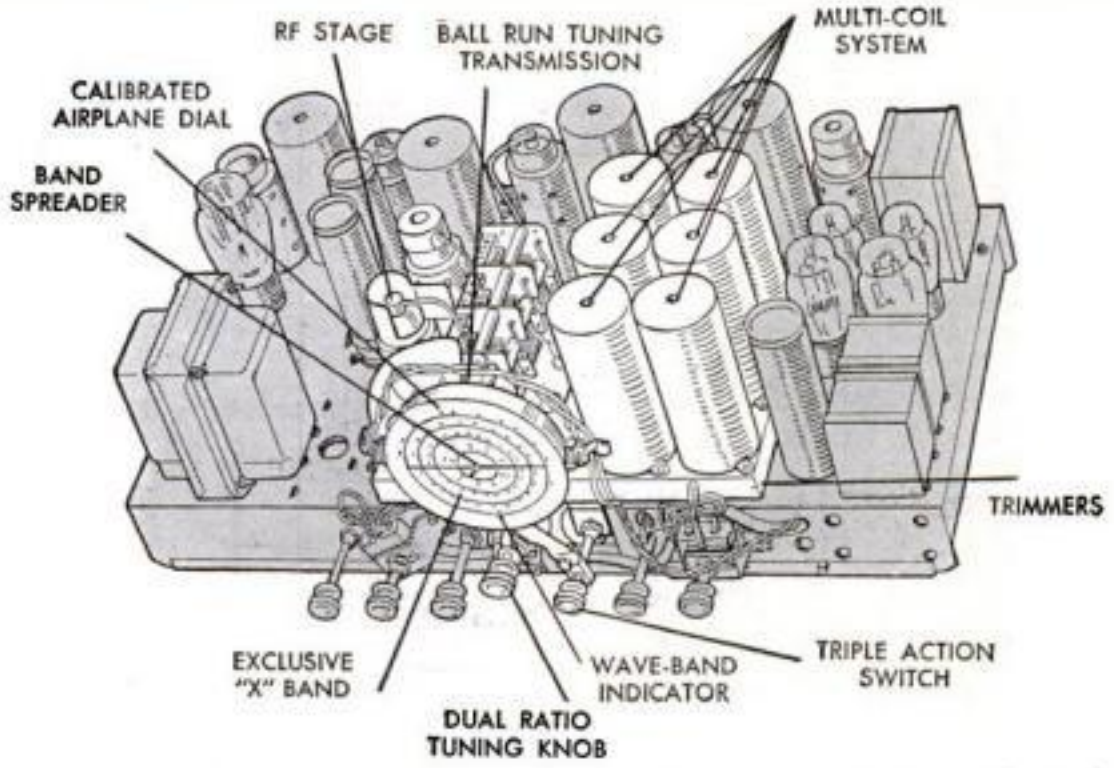

Here you see the relation of the "Magic Brain" to the rest of a typical 12-tube RCA Victor all-wave chassis. Indicated by the pointers are those parts of this unit which, acting in unison, produce the finest all-wave reception you've ever heard!

RCA Victor engineers produce uncanny governing unit in all-wave chassis that is directing force for superior long- and short-wave performance

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What are the 3 reasons for the RF stage?
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Why is it so necessary?
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FOUNDED MONTHLY 1872

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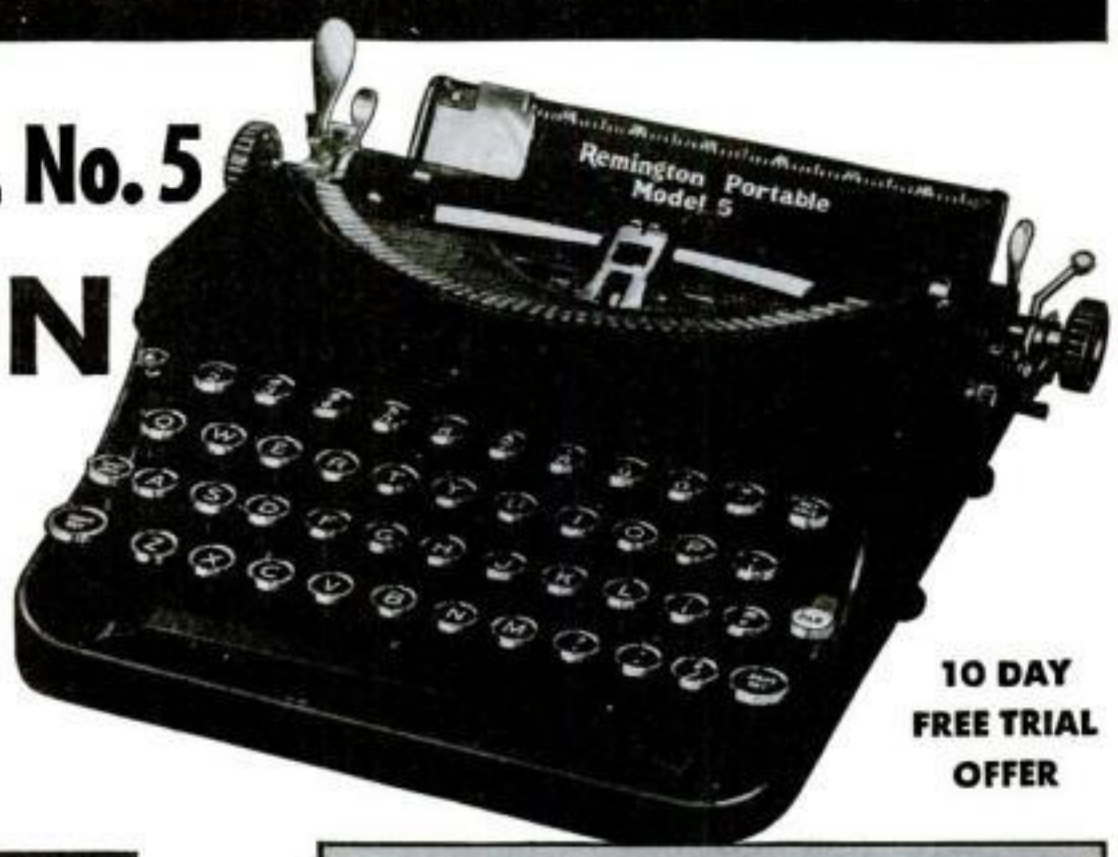

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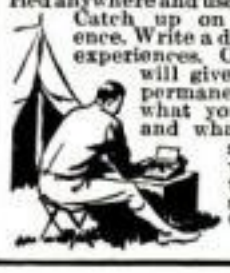

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Statement of Ownership, Management, Circulation, etc., required by the Act of Congress of March 3, 1933, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1934. State of New York, County of New York, ss. Before me, a notary public in and for the State and county aforesaid, personally appeared A. L. Cole, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of March 3, 1933, embodied in Section 537, Postal Laws and Regulations, printed on the reverse of this form to wit:

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(Signed) A. L. Cole, Business Manager.

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(Seal) My Commission expires March 30, 1936.

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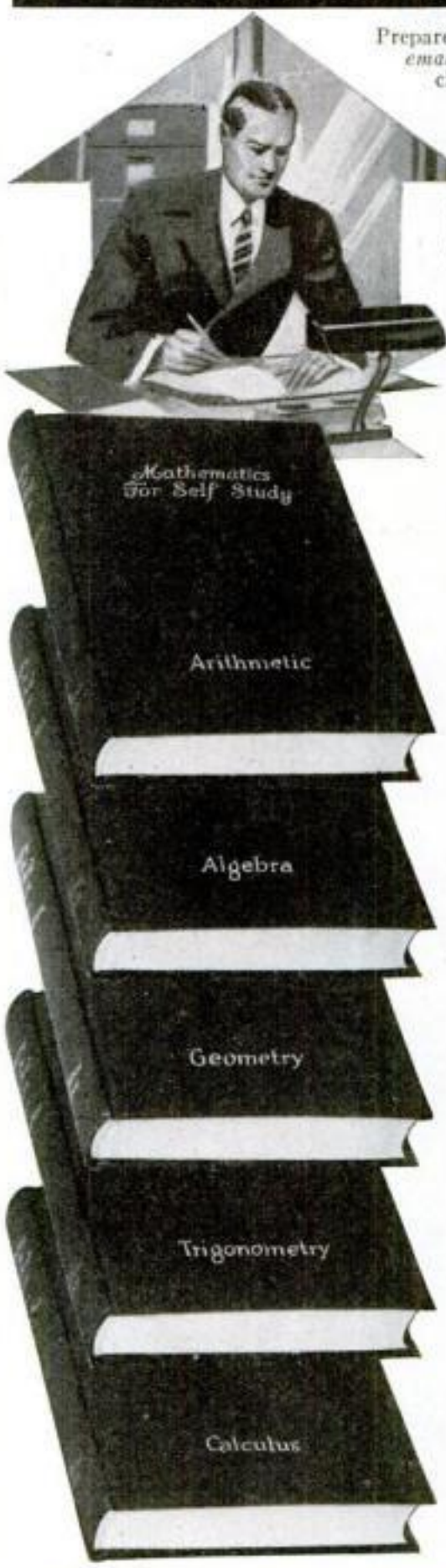

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STRANGE, BUT TRUE

(A) CANNED SPIGOT WATER . . . sold for big money in the U. S. last year and thousands of people bought it. Why? (See answer below.)

(B) IN LITTLE AMERICA . . . . where 60 degrees below zero is not uncommon, water-cooled motors operate without danger of freeze-up. How are such motors protected? (See answer below.)

(C) ENGINES OF MODERN HIGH-SPEED CARS . . . are designed to deliver maximum power at relatively high cooling-system temperatures. Yet lots of people still use old-fashioned anti-freeze *which boils away* before such temperatures are reached. Why? (See answer below.)

(A) They didn't know that many anti-freezes contain 10 to 40% plain spigot water. When you buy Eveready Prestone you get a *concentrated* anti-freeze; you add the necessary water yourself . . . you don't pay for canning and shipping it.

(B) Water-cooled motors in planes, snowmobiles and ice plants are protected with Eveready Prestone—chosen as the standard anti-freeze for Byrd Antarctic Expedition No. 2 because of satisfactory performance on the first Antarctic Expedition.

(C) Because they think boil-away anti-freeze is cheaper. Actually it is cheaper only at first. In the long run the least expensive all-Winter protection against both freeze-up and rust is provided by Eveready Prestone. (See chart on page 76B.)

Eveready Prestone is a *concentrated* anti-freeze. One shot is *guaranteed* to protect your car all Winter from freeze-up and rust. Economical, too. See chart on Page 76B for cost on your car and full Eveready Prestone guarantee.

TURN TO PAGE 76B

Squeaks can be taken out of floors by nailing down the loose ends of boards

SPARE-TIME

Floor Repairs

By R. M. BOLEN

Secretary, Popular Science Institute

NOTHING is more important to the general appearance of your home than the condition of its floors. A cracked ceiling may go unnoticed, but even a slight scratch or spot on a floor invariably stands out like a sore thumb.

Today, attractive floors are one household luxury anyone can afford. Whether you do the work yourself or pay someone to do it for you, floor refinishing heads the list of inexpensive renovating and modernizing jobs.

If your present floors are old and of an inferior soft-wood variety that scratch easily and splinter under wear, there are three possible methods of improvement. They can be painted, they can be covered with artistic linoleum, or they can be replaced with new hardwood floors. In a colonial or cottage-type home, paint is perhaps the least expensive solution. It is both attractive and long wearing. Coated with a waterproof paint or enamel in dark blue, gray, black, or green, even the most battle-scarred floors can be made to lend attractiveness and charm to modern as well as early-American surroundings.

Unlike most floor finishes, paint requires little surface preparation and has covering qualities that hide even the deepest bruises and the blackest spots. On old varnished or shellacked floors, simply remove the high gloss with sand paper, or by washing it with a weak solution of sal soda, and apply the paint. If the wood was stained originally, a new coat of thin shellac or aluminum paint will prevent troublesome "bleeding." In most cases, two or three coats of high-grade paint will be found sufficient to complete the job.

Lately solid-color and inlaid linoleums also have gained popularity as a floor finish. Modern linoleums are sturdy and easily cleaned, requiring only an occasional coating of special wax to keep them tidy and in the best of condition. Manufactured in a wide variety of textures and colors, they form an attractive and appropriate flooring for almost any room in any type house.

If new floors are desired, the home owner has such woods as oak, maple, beech, birch, ash, and yellow pine to choose from. For beauty and long life, quarter-sawed oak is, and always has been, in popular demand even though it is expensive. Rift-sawed yellow pine, on the other hand, besides being the cheapest, also offers good value for the money.

When a new floor is to be laid directly over the old, a rather thick stock should be used. This will prevent springing and supply strength to bridge any worn spots in the old surface. In most renovating jobs, the one-half- or five-eighths-inch boards prove the most practical. As to width, either one- and one-half-inch or two- and one-quarter-inch can be used. The narrower board, of course, is the stronger and more attractive.

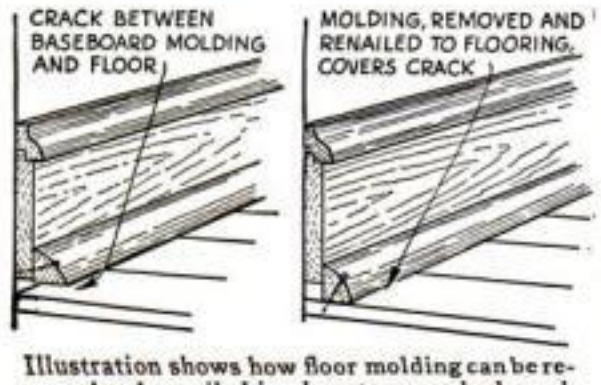

Illustration shows how floor molding can be removed and renailed in place to cover bad crack

In estimating the amount of lumber required to cover a specific area, it is important to allow an excess for waste and joints. In general practice, this amounts to fifty percent more than the actual floor area if one- and one-half-inch boards are used and about thirty-three percent for the two- and one-quarter-inch variety.

ONCE the old floor has been cleaned, dried, and covered with a good grade of waterproof paper, the new boards can be laid at right angles to the old. Start the first board by placing its groove to the wall after having removed the bottom half-round molding on the baseboard. Leave a one-half-inch space between the board and the base to allow for expansion and settling. The crack formed will be covered by the molding when it is nailed in place. Likewise, do not cut the boards too long; they need not be exact in length as the molding will conceal any irregularities.

For fastenings, sixpenny wire finishing nails or cement-coated nails can be used. These should be spaced not farther than sixteen inches apart and should be driven into the board at an angle of approximately fifty degrees just above the tongue. In high-grade work, a set can be used to drive the nails below the surface to provide a snug fit in the adjacent groove. If by any chance a tongue is splintered or broken by the hammer, it should be removed to allow the next board to fit tightly.

In finishing new hardwood floors and in refinishing old ones, the home owner can lighten his work by taking advantage of certain new materials and methods. There was a time when floors had to be scraped by hand. Today, motor-driven sanders replace elbow grease. In almost every locality, powered sanders can be borrowed from hardware stores and paint shops. Rented for a few dollars a day, they come complete with wire brushes, and sanding and polishing attachments.

New bleachers and varnish removers also make refinishing floors a simpler problem. Applied with a brush like paint, they soften the old finish so it can be scraped off with a putty knife, and also in many cases they bleach the wood back to its original beauty.

The best type of filler to use on a new or an old floor depends on the wood. Close-grained woods, such as ash, beech, birch, and maple, require no filler, while oak, an open grained wood, requires a paste filler. Finally, because it has a soft grain, yellow pine requires a liquid filler.

Paste filler should be thinned with turpentine to a brushing consistency and applied by brushing it first across the grain with a stiff brush, allowing it to dry for about thirty minutes, and then removing the excess by wiping across the grain with clean burlap or excelsior. After twelve hours, the surface should be sanded lightly and wiped clean with a benzine-moistened cloth. Liquid filler is applied with a brush just as it comes from the can.

IF THE final finish is to be varnish, apply it with a full brush across the grain and then brush it lightly with the grain. At least two coats should be applied with from forty-eight to seventy-two hours allowed between coats for drying. It is important in all *(Continued on page 9)*

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HOW TO REPAIR FLOORS IN YOUR SPARE TIME

(Continued from page 7)

varnish work that the room temperature be at least seventy degrees Fahrenheit.

Shellac, although applied in much the same manner, must be brushed on quickly to avoid marked overlaps. It dries faster than varnish and generally two coats applied two hours apart are sufficient.

A relatively new type of finish, called the seal finish, is gaining in popularity in both new and old work. Combining the action of both the filler and the outer finish, it penetrates the wood and seals the surface against dirt, grease, and moisture. It is applied with a lamb's-wool mop or a brush, the final coat being buffed with a polisher or electric polishing machine.

Not every floor-repair job calls for complete refinishing and polishing. In many cases, the home owner can improve the appearance of existing flooring merely by removing squeaks and hiding the telltale marks of normal settling. For instance, loose boards that invariably cause annoying squeaks generally can be silenced with a few wire nails. First, find the loose end of the board that is causing the trouble. Then, drill two holes through the board at opposite angles. Finally, drive in the finishing nails and cover their heads with putty.

In a similar way, a few minutes spent with a hammer and nail set can remedy the unsightly cracks that often develop between the baseboard molding and the flooring. In cases where these cracks occur, it will be found that the half-round molding at the bottom of the baseboard has been nailed to the baseboard instead of the flooring. Simply loosen the molding strip, remove the nails, and renail it in place by sinking the nails into the floor boards. Any additional settling then will merely pull the baseboard away from the floor but the crack formed will be covered by the molding attached to the floor.

Cracks also often develop between boards in a floor because of settling. If small, they can be filled with putty, but large openings should be filled with wood.

The cracks are cleaned by drawing a bevel-edged chisel along them. Then from a one-half-inch board saw a long strip, a trifle wider than the crack, with a bevel on one edge. Spread glue on the bottom and square edge, leaving the beveled edge dry, and drive the strip into the crack. When the glue dries, the strip can be sanded or scraped flush with the flooring.

IN CONCLUSION, a word about the care of floors will not be amiss. First of all, on any wood floor avoid the use of soap and water. Dust it with a floor mop and go over it occasionally with a rag or mop moistened with floor oil. As soon as the finish starts to show wear, a new coat of finish should be applied before the damage becomes too great.

Remember, floors are scuffed and scratched as is no other surface in the house. To keep them in first-class shape requires only a few minutes a month but to renew them, once they have reached the eyesore-stage, takes time and money.

Our Construction Kits *Will Help Solve Your* Christmas Problems

KIT G—*Revenge*

KIT F—Materials for 12-in. model of *Manhattan*

HANDMADE gifts outrank all others at Christmas. A neatly made ship model or a piece of hand-finished furniture is always welcomed. Unlike so many other Christmas presents, it has lasting value and will give pleasure for years to come.

In constructing gifts of this type, you can save yourself much time and trouble by making use of our construction kits. These are divided into classes, as shown in the following list.

Our standard ship model kits have all been especially designed for POPULAR SCIENCE MONTHLY by Capt. E. Armitage McCann, founder of the Ship Model Makers' Club. All the necessary raw materials are included, together with full-size blueprints and instructions. The models themselves, although not particularly hard to build, are of a very fine type, and the larger ones such as the *Hartford* and the *Wanderer* are worth several hundred dollars each if carefully constructed.

The easiest models to make are those designed by Theodore Gommi for the Popular Science Model-of-the-Month Club. They are beautiful little water-line models, made of balsa wood. A unique layer-built method of construction is used, so that they can be put together with no other tools than a pocketknife, some razor blades, and a pair of pliers. These kits contain all the raw materials, paints, blueprints, and instructions.

The simplified ship model kits form a third and intermediate classification. They are of the same general construction as our standard models, but are very much smaller and require much less work. In these kits the hulls are furnished roughly shaped, and various finished and semi-finished parts are included.

In the case of our furniture kits, all the machine work has been completed, and the parts can be put together after a little hand finishing and fitting have been done. These are distinctive custom-built designs and are of superior quality throughout. Only in the more expensive and exclusive furniture stores will you find their equal.

STANDARD SHIP MODEL KITS

A. Whaling Ship *Wanderer*, 20½-in...$6.90*
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D. Spanish galleon, 24-in..... 6.45*
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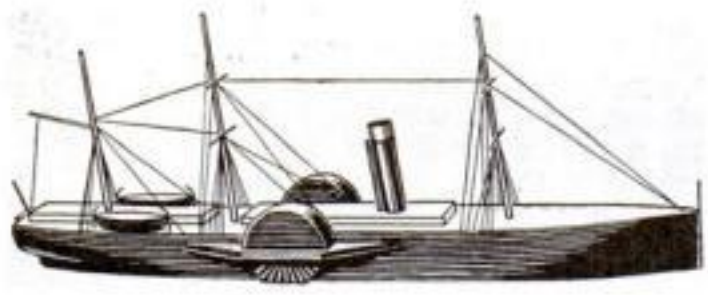
EE. Same with hull lifts sawed..... 7.45*
G. Elizabethan galleon *Revenge*, 25-in. 6.75*
GG. Same with hull blocks shaped..... 7.25*
L. Farragut's flagship *Hartford*, a steam-



KIT S—*Atlantic* (above) and *Savannah* (at left)

NO. 5

KIT D

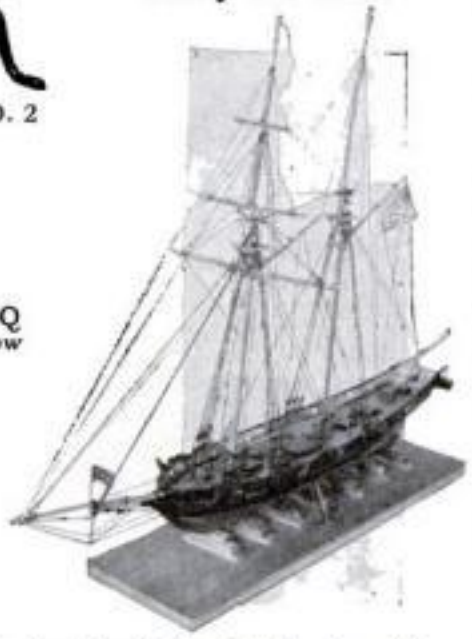
NO. 4

KIT E

KIT NO. 2

KIT J—*Sea Witch*

KIT Q
Swallow



This is Captain McCann's latest model

and-sail sloop-of-war, 33½-in. hull..... 7.95*
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F. Liner S.S. *Manhattan*, 12-in..... 1.00
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NOTE: If you live west of the Mississippi River, add 50 cents to all prices marked with an asterisk (*) because of the heavy shipping charges. Otherwise all prices are postpaid anywhere in the United States. The kits marked with an asterisk will be sent C. O. D. upon request, but the purchaser will have to pay 28 cents additional upon delivery.

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Our Readers Say

Maybe the Eskimos Do Use Electric Fans, After All

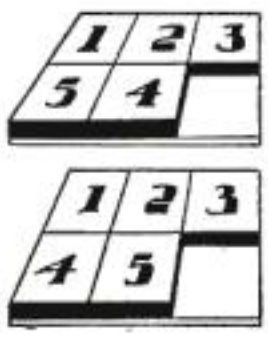
IN THE article "Is Your Idea Worth Patenting?" in the September issue, you have an illustration based on the idea that it would be irrational to try to sell a sled to a South Sea Islander. Quite true; but I would like to call to your attention the interesting but little-known fact that the Hawaiians (Polynesians, if not South Sea Islanders) enjoyed the sport of coasting, or sliding, centuries before Columbus was born. This was the sport of kings. Instead of using a sled on ice or snow, they would slide down grassy hillsides on bunches of Ti leaves. The Ti is a monocotyledonous plant whose pithy branches terminate in good-sized bunches of two-foot leaves. Down a steep hillside, seated on slippery leaves on dry grass, the Hawaiians would glide fully as rapidly as if coasting on ice with steel runners.—F.W.H., Waialua, Oahu, T.H.

This Shell Game Is A Matter of Inertia

THE problem of G.J., London, England, about the 100-pound, six-inch projectile, can easily be explained by Newton's first law. If you are in a airplane and are going at the same rate of speed as the projectile, the projectile in relation to the airplane is at complete rest. You simply come up under it and let it rest in the passenger cockpit. From then on it will act just the same as any other 100-pound weight in the airplane's body or cargo, and when you bank and turn, it will have no more of a tendency to continue in its original course than any other similar weight would have in the circumstances under the law of intertia. The plane itself would have the same momentum, in proportion to its mass. The deceptive part of this problem is that we consider the projectile, because it is a projectile, as going at a terrific speed. We forget that the mass of the plane is subject to the same laws. —O.A.N., Perth Amboy, N. J.

A Place for Everything —But Try To Put It There!

I HAVE a puzzle which seems difficult to me, and I wish you would publish it. Divide a piece of cardboard into six squares as shown in the diagram and number the squares from one to five. Cut out five pieces of cardboard and number them from one to five. Place these cards on the numbered squares, but in the order 1-2-3-5-4. The problem is to get all the cards on the squares of corresponding number. A card can be moved to a vacant square adjacent to it horizontally or vertically, but not diagonally. I hope to see a solution soon in Our Readers Say.—A.H., East Liverpool, Ohio.



Another Young Watchmaker Is Heard From

THE idea of G.S.G., Pittsfield, N. H., that you publish articles on watch and clock repairing, appeals to me. Although I am only fourteen years old, I have fixed many alarm clocks, mantel clocks, and watches. I put a mainspring in my seventeen-jewel watch and it worked fine. I find that the trouble in cheap clocks and watches is often in the balance wheel. If the tap at the end is adjusted and oiled, the timepiece will usually go again. Repairing clocks and watches is a fascinating hobby, and one at which the skillful amateur can save himself a considerable amount of money usually spent for minor repairs. A series of articles on this subject would be appreciated.—K.N.P., Ashland, Va.

He Must Have Met a Road Hog the Day He Wrote This

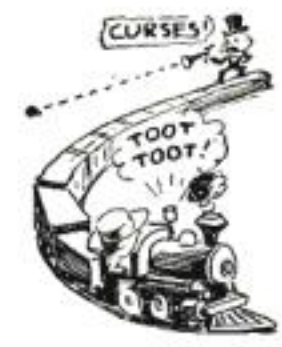
ON PAGE 21 of your October issue I see a very polite little gadget for automobiles, that flashes, "Thank you," fore and aft when the dashboard control is worked. That's fine. With knee-action cars, it ought to be possible to drop a curtsy, too. But that little device would be completely tongue-tied out here where men are men and motorists are eloquent. It just hasn't got the vocabulary. Assuming that you do want to say "Thank you" sometimes, what are you going to do on those more frequent occasions when the only fitting remark is, "Where the heck do you think you're going?" or "Who told you that you could drive a car?"? Of course, you could have a panel with a wide selection of remarks, and a row of buttons to illuminate the one that seems appropriate. The best thing I've seen so far, though, is the little rubber thing you put on the exhaust. When you pull the string it gives a perfect rendition of that undignified noise variously known as the bird, Bronx cheer, and razzberry. In my experience, this covers about ninety per cent of the demands for inter-driver communication.—B.A.H., Reno, Nev.

The Bee Controversy Ends —With a Sting, of Course

THANKS, E.C.B., Sioux City, Iowa, for admitting, in the September issue, that you were mistaken when you stated that worker bees "have no sex and are neither male nor female." And, although you at first called me "dumb," thanks for admitting that I was right when I corrected your statement. Your only claim now is that you have "a perfect right to call a worker bee a neuter if you feel like it." Certainly, you have a perfect right to call it a neuter, or a bumble-bee, or a hornet, or anything else, if you feel like it, but that does not make it anything but a female worker bee. Every reference you gave that mentions the word "neuter" states that, no matter what you call them, worker bees are females. Yes, E.C.B., now that you have learned what a worker bee really is, regardless of what you call it, let's quit.—C.H.P., Canaan, Conn.

But Why Shoot at the Engineer, Anyway?

HERE is a problem I would like some of your brilliant readers to solve: Two men are at opposite ends of a freight train, which is going fifty miles an hour. The man in the caboose shoots at the man in the engine and the bullet travels exactly fifty miles an hour also. Would the bullet ever hit the man in the engine? The more I think of it the harder it gets, so I hope someone answers it with proof. This ought to be a pushover for some of your mathematically-minded readers. — B.H., Georgetown, Ky.



E.A.T.'s Green Dots Are Identified as Chlorophyceae

THE letter of E.A.T., Charlotte, N. C., states that he discovered under his microscope a colony of blue-green dots held together by protoplasm. I believe that what he saw was the volvox, or colonial green algae, which may be found in aquariums. Volvox is a colonial form consisting of many cells embedded in a jellylike substance. This seems to answer E.A.T.'s description of the objects he saw, and the water he was examining came from an indoor aquarium, according to his report. They may develop to the size of pinheads and roll through the water like a porcelain platter. For further information he might look in any botany book under the heading of Chlorophyceae or green algae.—H.B.P., San Francisco, Calif.

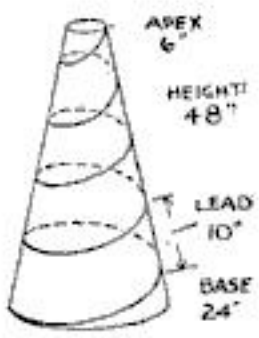
A Friend of Morpheus Bans Synthetic Slumber

AS ONE of your most faithful readers, I wish to protest against the suggestion made by R.P.B., Baltimore, Md., in the October issue. He wants the scientists to go to work and discover a substitute for sleep, so that we can stay up all night and watch civilization advance. I'm not exactly a cynic, but I believe that the world would be a better place if most people slept eighteen hours a day instead of eight. You never heard of anybody getting into trouble while he was asleep. Science is all right in its place, but when it goes to giving us tabloid food, canned music, and voluntary insomnia, it's all wet. I like my sleep, and the only thing that can keep me from getting it is a new issue of POPULAR SCIENCE MONTHLY. I suggest that R.P.B. hang around a night club for a while and see

how fast civilization advances around two o'clock in the morning.—B.E.D., Davenport, Iowa.

Now For a Little Fun With a Frustum

I AM submitting two problems that may be of interest to your readers. First, to find the length of a conical helix or tapered spiral impressed (wound) around a frustum of the dimensions given below. Consider the helix as having no diameter, as a line has no width. The lead, or distance between turns of the helix, measured along the slant height, is ten inches; the vertical height of the frustum is forty-eight inches; diameter of larger base, twenty-four inches; diameter of smaller base, six inches. The helix extends between the two bases. Second, a problem in physics: A cube of steel one inch on the edge is taken, with initial temperature of zero degrees Fahrenheit, and put into a furnace or heating oven whose temperature is 600 degrees Fahrenheit. What length of time is required to heat the cube throughout to the same temperature as the heating oven?—E.A., Sault Sainte Marie, Mich.



An Inveterate Cut-up Supports the Dissection Movement

I AGREE with M.G., New York City, about the amateur dissection department. I have cut up all sorts of creatures from the flea to the horse since I was fourteen years old, and of course I have quite a bit of data on autopsies and post-mortem examinations of animals. Another request I would make is that you publish plans for constructing X-ray and high-frequency machines. This apparatus would be a great aid to me in my work on animals.—J.J.H., Detroit, Mich.

They Have Rainbows at Night in Hawaii, Too

I WAS interested in the account given by G.S., Sydney, Australia, of the rainbow he saw at night. I came to the Hawaiian Islands in 1923 and soon heard about the nocturnal rainbows which are quite common in the valleys near Honolulu.—E.M.J., Honolulu, T.H.

A Department To Advise Puzzled Inventors

As an improvement to your magazine, why not open a "What To Invent" department? Things of this kind are already being published, but they are gotten up by people who have no connection with real technical and industrial problems. Therefore, I suggest that you write letters to various industrial companies—chemical, mechanical, railroad, electrical, automobile, shipbuilding, war supply, and so forth—asking them to give you any problems concerning improvements and new inventions needed in their special fields. The answers should be by no means brief or popular, but very exact and technical, providing information as to what has already been done in the same line. You would publish these facts for the information of inventors. I am personally interested in such articles because I am a civil engineer with an inventive turn of mind, unemployed at present on account of the depression.—V.E.H., Los Angeles, Calif.

Apparently Darwin Never Thought of This

IN REGARD to evolution, I think that a good argument against it is chemistry. Take, for instance, water, H_2O. It has been here since a long time before man, and it has not changed. Neither have any of the ninety-two original elements. They combine in fixed, unchanging proportions. I do not believe that it can be shown that anything else has changed materially, either.—L.S.B., Fullerton, Calif.

This Would Make Us Angels, One Way or Another

I HAVE heard of people raising themselves as high as ten feet in the air on birdlike wings and others, as a sport on the seashore, jumping as high as fifteen or more feet with the aid of spherical balloons. I wonder why no one has thought of combining these two ideas by devising an outfit which would include a pair of wings, made of canvas stretched on a light-weight frame of proper size and proportions, together with a balloon of the dirigible type, of such dimensions that it would suspend a weight about half that of a man. This aerostat could be divided into three or four compartments to offer greater assurance of safety. The wings could be attached to the man's arms so as to be swung by the same motion as a bird's, while the dirigible, attached by straps from above, would give a certain amount of buoyancy. The man's body would preferably be in a horizontal position in the air. The wings would have a concave shape underneath and consist of two leaves, divided longitudinally and hinged in the middle so that when swung upwards they would fold, and when swung downward they would open and be held in that position by a catcher at the hinges. This movement would make the necessary resistance through the air to raise the man almost vertically and propel him through space. Direction could be controlled by twisting the arms and hands. The legs might be equipped with flaps, if this were found necessary to maintain equilibrium. Such a method of flying would possess many advantages over present-day gliders. It would make it possible to go up in the air without jumping from a hilltop or being trailed by an airplane. In strong winds, the balloon would prevent false currents from dashing the operator to earth. It could land almost anywhere. Speed would not be great, because of the resistance offered by the balloon, but this would be compensated by the greater safety. Other essential features I will leave to the experimenters to discover. —J.B.L., Sao Paulo, Brazil.

Inventor Suggests Wiring Jails for Sound

YOU often hear of criminals getting out of jail by sawing through the bars, but I have an idea that I could build a jail that nobody could get out of. I would make the bars of the cells hollow, and run an electric wire through each. There would be a panel in the main office with a light for every cell in the jail. Sawing a bar would flash the light corresponding to the cell, or ring a bell, and an officer could go right to the place where the escape was being attempted. You could even have wires in pipes all through the walls of the building. Then a prisoner could not get out either through the walls or through the doors or windows. What do you think of the idea? A friend of mine suggested putting in hollow bars with rollers inside, so that a saw could not get a grip. The trouble with this is that the prisoners would soon get onto the trick of boring a hole through the hollow bar and putting in a pin to keep it from turning. —J.H.J., Kansas City, Mo.

Never Start an Argument With a Stamp Collector

I SHOULD like to ask G.D., of Jamaica, N. Y., a few questions which came to me after reading his reply to my letter in Our Readers Say: Would he advise a person not to collect stamps just because he could not tell a fake stamp from a genuine one? Does he think that every stamp collector has to be a chemist? How many collectors are there in this country who use chemicals (other than benzine to see watermarks) to tell a true stamp from a fake? I am sure that most collectors would answer "No" to the first two questions and "Not many" to the third. I hope you will publish this letter so that readers of Our Readers Say won't think that they have to study chemistry before taking up the greatest hobby in the world, stamp collecting.—F.H.S., Bangor, Me.

J.B.K. Should Have Stretched His Imagination, Too

ANSWERING the question of J.B.K., Bellefont, Kans., relative to the space between the earth and a wire which was originally equal in length to the circumference of the earth and to which 100 feet of wire has been added. The answer depends on the simple mathematical relationship between circumference and diameter. Consequently, 100 feet added to the wire must result in a new circle 100 feet greater in circumference and therefore 31.8 feet greater in diameter or 15.9 feet greater in radius. An old trick in mathematics instruction was to present the problem as stated by J.B.K. and then ask, "If we now take a ball one foot in diameter and stretch a wire around it, then add 100 feet to the wire and again stretch it so that there is the same space all around, would the space be greater or less than in the first example?" While the contrast is confusing at first thought, the answer is obviously that 100 feet added to any circumference results in the same amount of increase in the diameter and consequently in the radius, which affects the distance from the original circle in the problem given.—G.A., Brooklyn, N. Y.

Try This Crystal in Your Microscope

I HAVE a microscope and my specialty is crystals. Here is a good formula for a beautiful crystal: a pinch of Epsom salts and a drop of boric acid (liquid). It's worth looking at.—D.M., Peru, Ind.

And the Grass Is Barely Up After the Goat Problem

BY THIS time, I am sure, C.C.B., of Los Angeles, Calif., has been told where the so-called "extra square inch" came from. The area he was so anxious to find is just plain open space. Now let *him* answer one: A cow is tied to the fence of a circular field containing an area of exactly five acres, by a length of rope sufficient to allow her to graze over one acre. How long is the rope? My diagram illustrates the problem, which ought to give a little entertainment to your pasturage experts. —J.B.B., Alexandria, Va.

How Science Measures "Auto-Fatigue"

By Andrew H. Ryan, M. D.

Dr. A. H. Ryan, well-known authority, tells you here exactly how he measured the effects of "auto-fatigue" on the human body during motoring, and the astounding facts he discovered.

IT IS a well-known fact that thousands and thousands of motorists suffer from 'auto-fatigue.' That is, long, hard drives, covering great mileage, or city driving with its difficult traffic conditions, often produce physical and nervous exhaustion.

"In my laboratory at Chicago, we determined to make a sound, scientific study of the nature and extent of this exhaustion, and to find out how it might be overcome, if possible.

"First, I developed or adapted a number of special instruments, all highly delicate in nature, to make these experiments.

"As subjects, I chose several carefully picked college men, and put them through a series of experiments extending over several weeks. Each driver received the same tests under practically the same conditions.

"Records were taken every morning before the driving started, then the men set out in a body, using different makes of cars, for 200 to 400-mile trips. Records were kept at varying intervals during the drive, and a complete comparison made at the conclusion.

"Thus, after a man had driven 400-miles, we could check accurately how much fatigue and exhaustion he suffered, in contrast to his condition at the beginning of the day.

"Figures for each make of car were kept, and I was interested to note that the drivers on the Dodge car showed 54% to 65% less nervous and muscular impairment due to fatigue, than drivers on other cars tested."

Easy On Your Pocketbook, Too!

The sensational engineering advancements that give the big Dodge its easier riding qualities, have an important bearing on economy, too. Vibration—the enemy that is slowly, steadily shaking ordinary cars to pieces—is smothered, so Dodge lasts longer. You don't have to pay out money for the repair bills that constant vibration causes, either.

Remember, the name Dodge on the car you buy means that it is backed up by nearly 20 years experience in building nearly three million fine vehicles. Engineering genius is matched by manufacturing genius! The result is reflected in important operating economies. For example, Dodge owners report 17 to 22 miles on a gallon of gas. Hydraulic brakes are not only self-equalizing—for safe, smooth stops without swerving—they also save both tires and brake linings. Valve seat inserts save gas, postpone valve grinding for thousands of extra miles. Dodge is so well and carefully built that it is bound to save you money, be a better investment for you.

Dodge Advantages

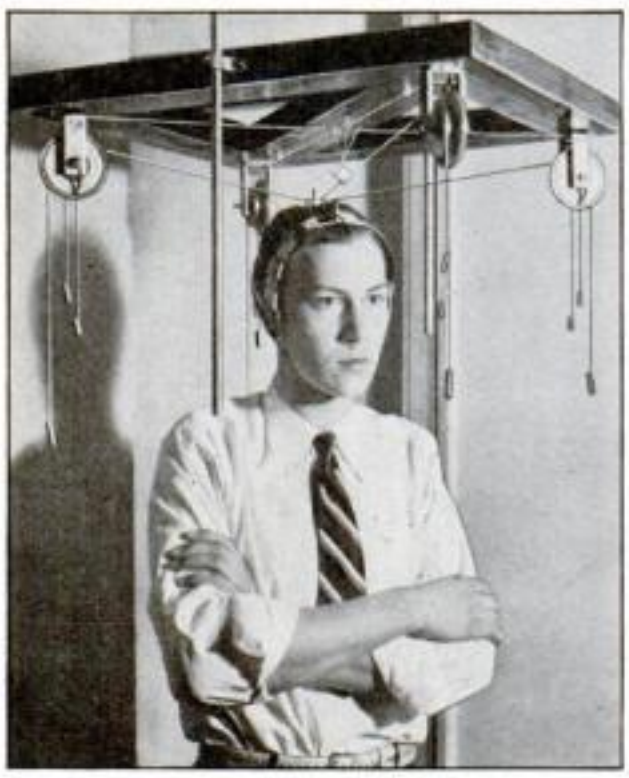
The astounding results of Dr. Ryan's tests are due to basic and radical advantages in Dodge engineering—to dozens of special comfort features that make riding easier. By a remarkable invention known as Floating Power engine mountings, vibration in a Dodge is completely smothered. Then, too, Dodge utilizes rubber at 56 vital points—protection against road shock, noise, bumps, and rough riding.

The Dodge type of independent front-wheel suspension is also a means of increasing comfort.

The easy action of hydraulic brakes assures easier, smoother operation—less fatigue.

Make This Test Yourself

Go to any Dodge dealer and ask for a free copy of the booklet describing Dr. Ryan's tests. Drive a Dodge. See for yourself that Dodge is easier to drive, that it is easier on your nerves, that it gives an entirely new kind of comfort. Dodge Brothers Corporation, Division of Chrysler Motors.



POSTURAL STEADINESS TEST—This sensitive instrument measures the amount of body sway (a sign of fatigue). Measurements were taken before and after the long test drives.

HAND-EYE COORDINATION TEST—measures the impairment to manual and visual steadiness, and effects on the coordination of hand and eye, resulting from driving fatigue.

VASCULAR SKIN REACTION TEST—This instrument records the reaction of the blood vessels of the skin to a tired nerve condition. Tests were made before and after the long drive.

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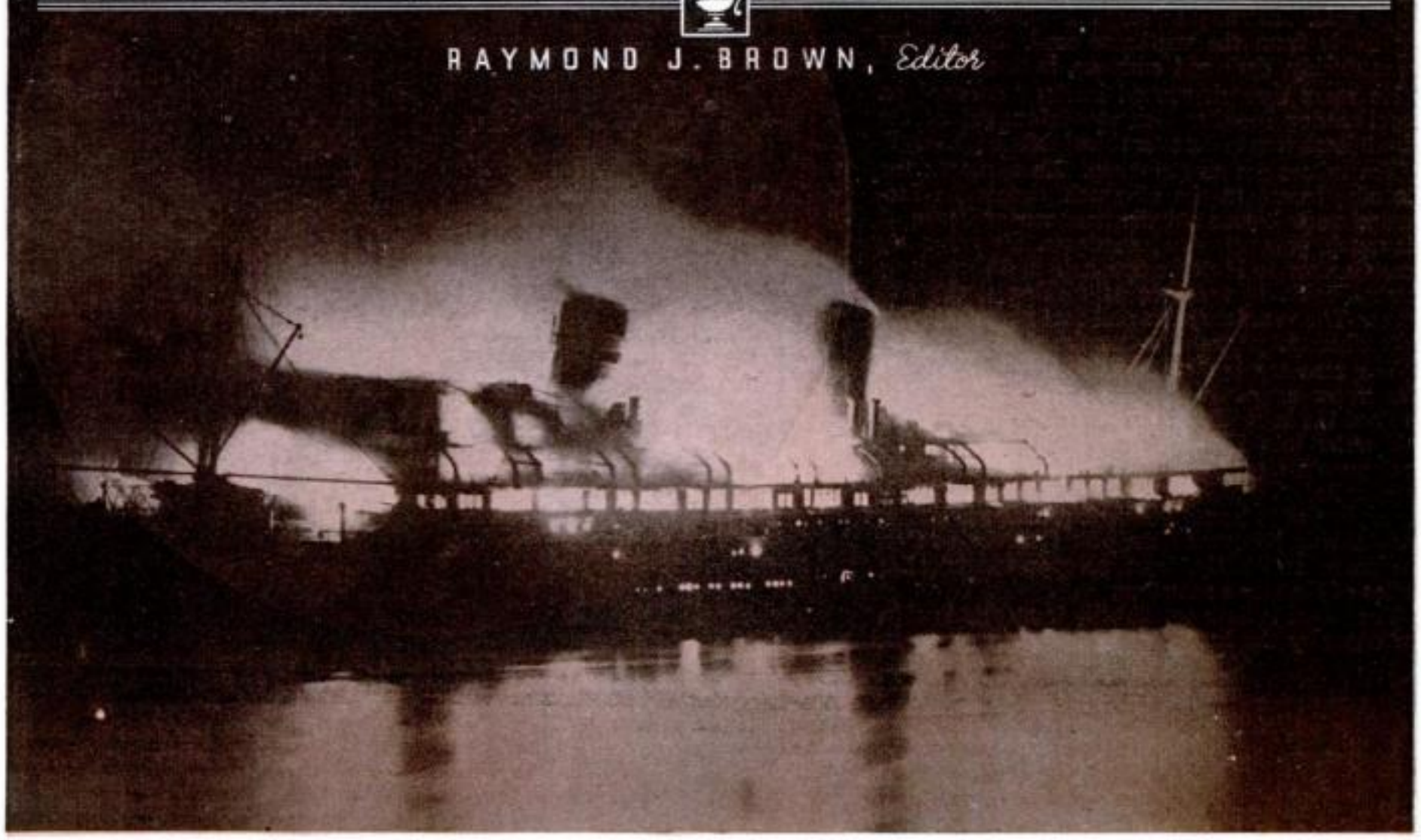
RAYMOND J. BROWN, *Editor*



FIRE at SEA

A Challenge to Science

By JOHN E. LODGE

FLAMES which turned the luxurious liner, *Morro Castle,* into a pillar of fire off the New Jersey coast, a few weeks ago, have lighted up once more the age-old problem of fighting fires on the sea. With more than 100 persons dead in this greatest of recent marine disasters, people all over the world are asking: Can such tragedies be ended? Can completely fireproof ships be built? Can science bring safety to the sea?

In search for the answers to these universal queries, I have talked with steamship officials, with naval architects, and with fire prevention experts. They have told me what they have done and what they plan to do. They have showed me innovations and ingenious mechanisms which they hope will go far to eliminate the human element and automatically throttle fires before they can spread.

In recent years, crack new liners, designed by able naval architects according to rigid Government specifications and built in the best shipyards in the world, have been victims of fire. The French giant, *L'Atlantique,* burned in the English Channel last year, a $20,000,000 loss. Twelve months before, another ace ship of the French merchant marine, the *George Philippar,* was gutted by fire in the Gulf of Aden. About the same time, the *Bienville,* pride of the Southern Pacific fleet, burned at New Orleans, La., with a million-dollar loss. The North German Lloyd liner, *Muenchen,* was destroyed by flames in New York Harbor; the *Segovia* went up in smoke at the pier of her builders in Newport News, Va., and the palatial British motorship, the *Bermuda,* burned in the harbor of Belfast, Ireland.

At exactly the time the *Morro Castle* was becoming a floating torch, seven miles from shore, the Grace liner, *Santa Rita,* was racing up the Pacific for Balboa, Canal Zone, with a fire in her hold. From Calcutta, India, from Honolulu, Hawaii, from Seattle, Washington, have come reports in recent years of burning liners. This trail of maritime disasters encircling the globe is a challenge to science:

Is this the best you can do?

The answer is: No!

Before we see why the answer is justified, let's run back for a moment over the progress that has been made. Take a single example from the annals of the sea: It is a bright May morning on the North Atlantic. The Royal Star

freighter, *St. George*, is ramming her bow into crisp and foam-streaked billows. Her hold is packed with cotton bales and bags of castor beans.

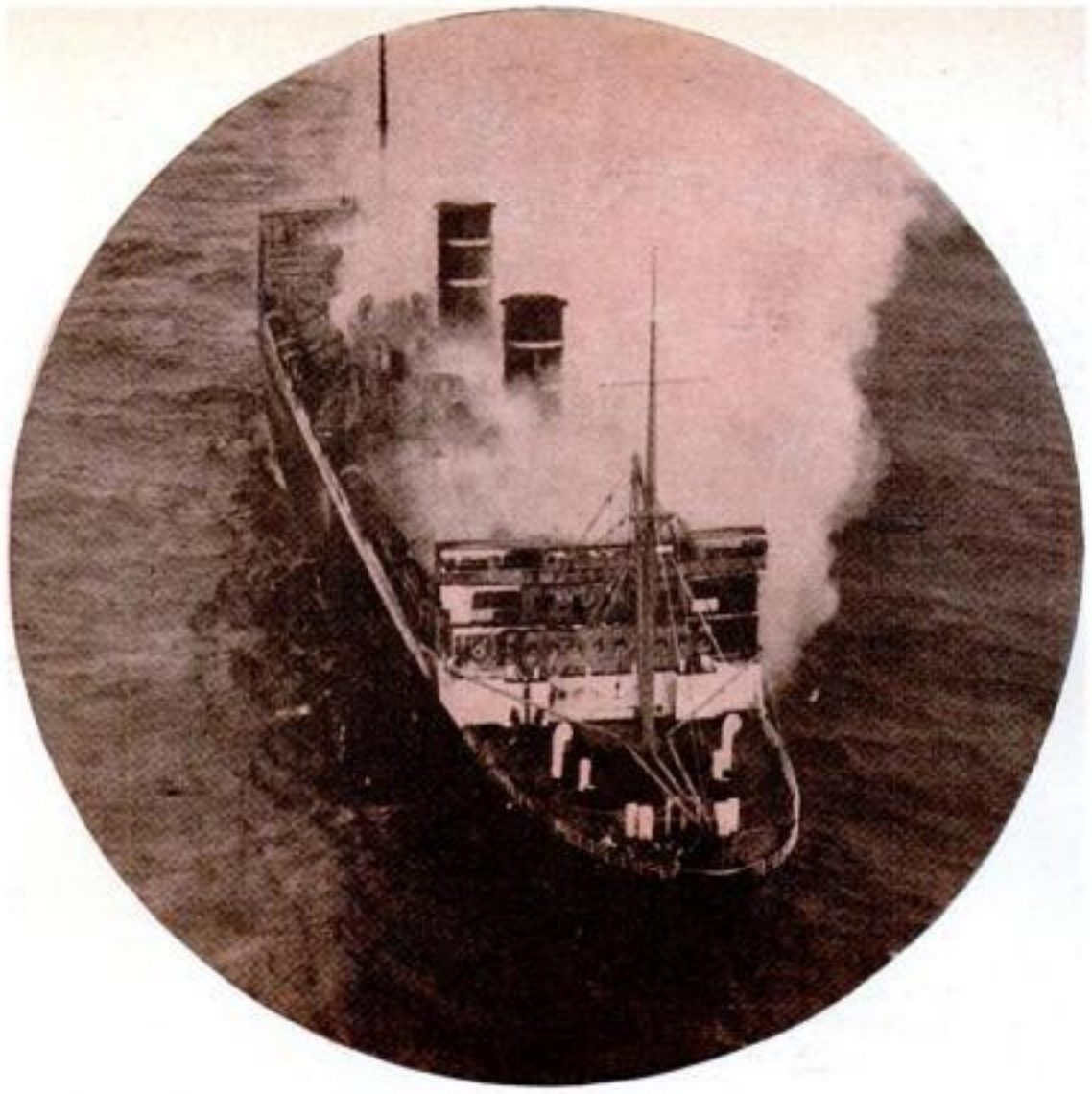
On the bridge, the officer of the watch balances himself on heels and toes to the lift and fall of the heavily laden ship. His gaze wanders from two sailors splicing hemp cable on the forward deck to the tall hooded ventilator leading to Number One cargo hold. Instantly he snaps to attention. Curling thinly from the ventilator cowl, then coming more thickly, dark and ominous, is smoke!

He roars through cupped hands: "Forward on deck! Swing Number One ventilators out of the wind! Lash tarpaulins over them! Make it lively!"

The sailors are on the jump. He summons the Captain, turns out the off-watch, orders the fire-pumps started, runs out the hose, and, relieved of his watch, goes below to investigate. He cautiously opens a door to Number One hold and then slams it shut again in the face of rushing smoke and flame. The ventilators are still forcing air into the hold where fifty tons of cotton are ablaze.

The men try fighting the fire with steam jets. The vapor seems to help the blaze. They decide to flood the hold. Hour after hour, the pumps pour salt water into Number One. But the walls and deck grow hotter. The cotton in Number Two hold catches fire. Then Number Three, packed with oily beans, begins to burn. The deck planking is curling and smoking. Spurts of flame pour from the hatches, the ports, and lastly, from between the buckling plates of the ship's structure.

The vessel is hove to. It rolls from side to side, far down by the head, loaded with tons of water.



This aerial view of the *Morro Castle* shows her blazing from stem to stern

Left, a new smoke detector with the cover removed to show interior mechanism. The lights at bottom shine through tubes so escaping smoke glows like fire. Below, valve manifold by means of which smothering gas is turned into the hold

Here is a typical cargo protecting system. In these cylinders is stored the carbon dioxide which, released into a burning hold, will smother the flames without damaging the cargo.

For forty-eight hours, the men battle the flames. Boats are slung overside. Finally, with a crackling roar, a steel hatch cover collapses into a hold. From the opening, a pillar of smoke shoots skyward, streaked with sparks and flame. The battle is lost; the ship is doomed.

On the bridge, the Captain, burned and choking, gropes for the whistle-pull. The mournful blasts of "Abandon Ship" sound over the empty sea. Boats slide rapidly down into the water. The crew pulls to a safe distance and then waits to watch the end. The column of smoke rising above the funeral pyre of their ship, they hope, will bring a rescuer.

That is the story, repeated a hundred times, of fire at sea before the days of the radio and improved equipment. No matter how alert the crew might be, if fire began the odds were overwhelmingly against them.

In contrast, consider the experience of the *Santa Rita*. With sixty-six passengers aboard, this twin-screw, oil-burning liner was heading up the Pacific, 200 miles from Balboa, Canal Zone, early on the morning of September 9. Fire broke out in Hold Number Three. Immediately, emergency tanks of carbon dioxide, the colorless, heavy gas that puts the fizz in soda water, began pouring their contents into the hold. The gas settled toward the floor, formed a blanket of vapor over the burning material and kept the oxygen away. The flames died to a sullen glow and remained in this condition until the vessel docked at Balboa. Here marine firemen boarded her and extinguished the last of the blaze. None of the passengers had been in danger and the damage to the ship was slight.

Had the *St. George* carried this modern gift of science, her fire could have been held in check with equal ease. Liners now under construction will not only carry carbon dioxide but will have an ingenious network of inter-connecting pipes incorporated in their structures. Through these pipes, compressed carbon dioxide can be shot to any part of the vessel at a moment's notice.

Like nerves running from all parts of the body to the brain, these pipes will lead from all over the ship to a tiny room set on the bridge near the chart house. Hardly six feet square, such fire headquarters, in their simplest form, will contain three large, glass-fronted cabinets packed with numbered lights, annunciator flaps and flat nozzles. Around them and on the walls will be gongs of all sizes and tones, push-buttons, switches, telephones, and plans of the ship's

With this portable carbon-dioxide extinguisher, a small blaze can be fought. Note, the cloud of heavy gas

fire system with every protective device indicated.

Every hour of every day, whether the ship is in port or at sea, a trained fire guard will be on duty in this tiny compartment. All notifications of fire, whether automatic, vocal, or manual, will come here to be translated by the guard into split-second action.

Imagine, for instance, that a fire breaks out in the hold. The fire guard is sitting before his battery of nozzles and gongs reading a magazine. Suddenly, he lays it down and sniffs suspiciously. A faint acrid odor is increasing in the air. Glancing quickly at the cabinet containing the rows of flat, vertical nozzles, he sees smoke rising from one of them. The brass tag on the nozzle reads: "Lower Hold No. 4."

Instantly, the guard flashes word to the officer in charge of a battery of carbon-dioxide cylinders stored near the upper part of the engine room. Standing in long rows, like the pickets of a fence, these cylinders, often as many as 100, are connected to a manifold with valved branches leading to all the holds. Every opening to Number 4 is quickly closed. Then the officer opens a valve and carbon-dioxide under 1,500 pounds pressure rushes into the compartment. Flooding the hold, it chokes out the fire without damaging any of the goods which remain unburned.

When the officer opens the valve, he automatically cuts off the upper part of the pipe leading from Number 4 to the fire headquarters. This arrangement makes it possible to use the same pipes for the smoke alarms and the gas. The detector system at the cabinet continues to function for all other parts of the vessel while the fire is fought at one point. Fans, producing a continuous draft, draw air up the alarm pipes, thus bringing smoke to the lookout at the first menace of flames.

Not long ago, the Alaskan steamer, *Alameda,* nosed her way into the harbor at Seattle, Wash., loaded with copper. A short circuit started a blaze. The fire gained headway and strange lavender flames enveloped the super-structure. They came from the copper ore in the hold. Fireboats pulled alongside and fought the blaze. It was a losing battle. With acetylene torches, firemen cut their way through metal plates to rescue two trapped sailors. Finally, with hope of saving the vessel gone, tugs towed it out into the harbor away from other craft and let it burn. When the flames died down, a $600,000 ship had gone up in smoke. Only the warped and blistered hull remained. Rapid-fire use of a carbon-dioxide safety system probably would have saved the vessel.

In the case of the *Morro Castle,* alarm tubes had been installed running to the bridge. But, because they brought an odor of hides from a hold, according to testimony given at the investigation, the captain had ordered them stopped up.

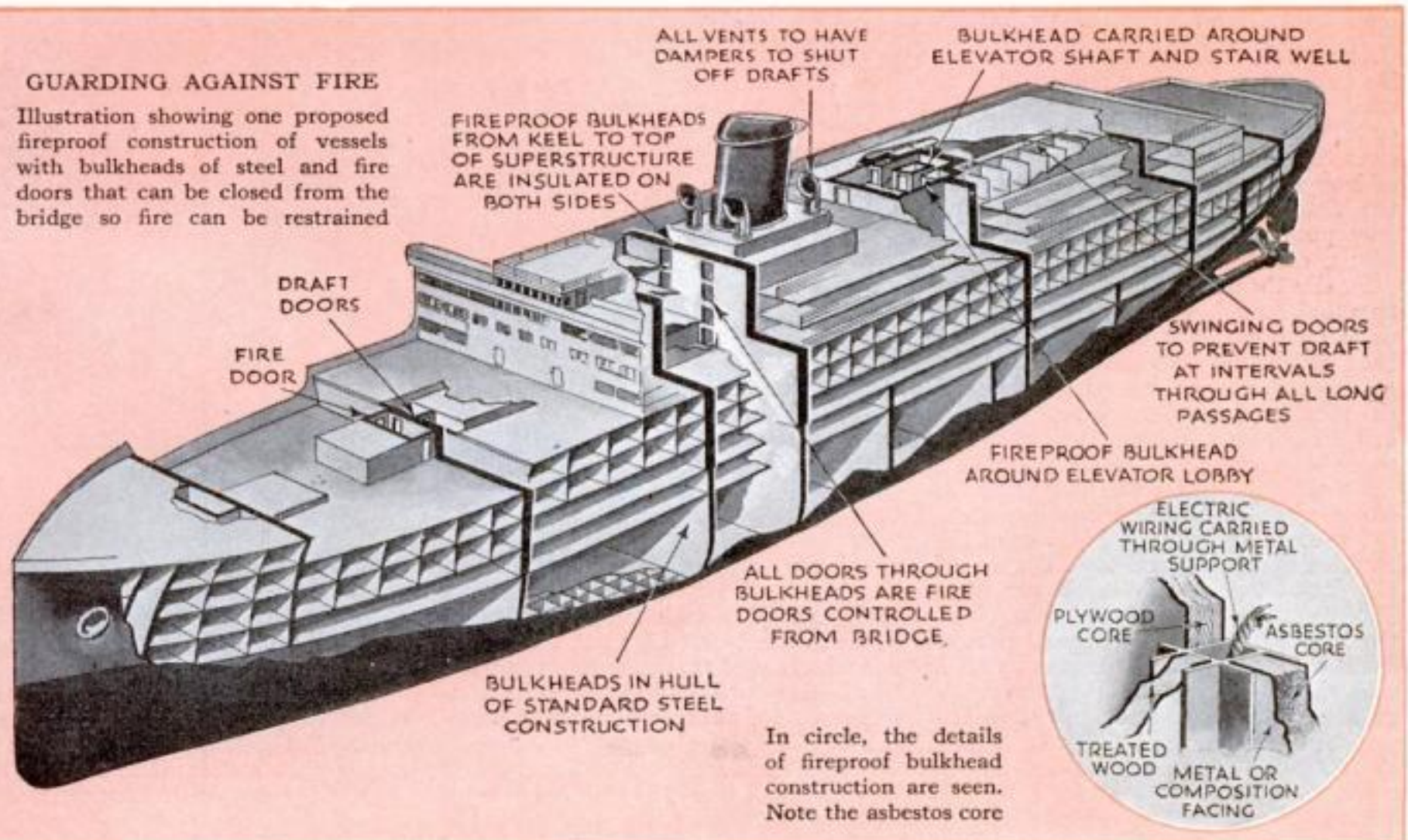
Thus, removing the human element from ship alarm systems is a major problem. It is the weak link which science is seeking to eliminate. By means of automatic mechanisms and light-sensitive metals and ingenious robots of the laboratory, experts are now blazing a trail toward systems independent of human action.

ONE group of research men, for example, has been experimenting with photo-electric cells, magic eyes which react instantly to any variation in the amount of light striking them. When smoke begins to pour from one of the nozzles, it cuts off a beam of light projected across the opening upon the cell and sounds an alarm.

Another adaptation of the alarm pipes makes it practically impossible to ignore the signals although they are entirely silent. If smoke issues from any of the openings, a light trained upward from within reflects from the particles and produces a striking display. A phosphorescent fountain seems to light up the wheelhouse. The quartermaster cannot overlook it and even the officer of the watch on the *(Continued on page 128)*

GUARDING AGAINST FIRE

Illustration showing one proposed fireproof construction of vessels with bulkheads of steel and fire doors that can be closed from the bridge so fire can be restrained



In circle, the details of fireproof bulkhead construction are seen. Note the asbestos core

Lone Finger Prints

By ANDREW R. BOONE

Latent finger prints are developed by dusting all surfaces that may have been touched by the guilty person

Capt. Howard Barlow, of the Los Angeles Police Department, shows how a photograph is made of a finger print. The camera is held in actual contact with surface

A finger print on the handle of this double boiler led to the arrest of a burglar who had used the pan to break a window. A dusting powder brought out the telltale print

AN HOUR before daybreak one morning a pale-faced young burglar glanced furtively up and down Wilshire Boulevard in Los Angeles, Calif. Making sure he was unobserved, he hurled a brick through the window of a store. Quickly he stepped in and helped himself to twelve machine guns and automatic pistols.

Soon the alarm sounded. Patrolmen in radio-equipped automobiles kept a silent lookout for all suspicious characters. Officer M. G. Gaskell arrived at the scene. He surveyed the wreckage and set to work with his magnifying glass and magic powders. The interior of the store yielded no clues. Then the officer turned to the litter of broken glass. For an hour he studied the shattered pieces, carefully dusting gray powder over the surface of each with a camel's-hair brush.

Finally the dim ridges of a single print appeared. Did it belong to the criminal or to some passer-by who had pressed a hand against the glass while peering in at goods on display? From its position and size officers quickly deduced that the print had been impressed by a right thumb—that the burglar, in his haste, had pulled out a splinter of glass which his smashing blow had failed to dislodge.

The scene shifts to a quiet room of the Division of Record and Identification of the Los Angeles Police Department. Holding in his left hand a photograph of the lone print, Captain Howard Barlow bends over a card-filled file comparing it with right-thumb prints of known criminals. He finds a duplicate! The impression on the glass belongs to a man already twice imprisoned for serious violations of law.

Hardly had detectives, armed with photographs of the criminal, commenced their search when a patrolman surprised a burglar in a downtown store. Searchers comparing his prints with those of "wanted" outlaws, found that his right thumb tallied with that of the machine-gun burglar. Confronted with this evidence he confessed and led officers to the stolen weapons.

Such dramas are being written daily by Los Angeles police officers through positive identifications in the form of single finger prints. When, ten years ago, Captain Barlow evolved a simple system of classifying "lone wolf" prints he started a file which today contains 50,000 individual prints from 10,000 known burglars, robbers, murderers, kidnapers, receivers of stolen property, and thieves. These prints have brought about the arrest of 1,300 persons wanted for crimes ranging from dynamiting to murder and have wrung confessions from or convicted 1,235.

The single finger-print file now provides a means whereby a chance impression from the scene of a crime may be successfully identified. Identification of its owner depends upon legibility of the print and the existence of a duplicate in the file. Material for the file is obtained through duplicate copies of finger prints.

The first segregation in the Single File, as it is called, is by fingers. Each thumb, for instance, has a compartment all its own. Each digit is further divided according to pattern, such as loop, whorl, central pocket, lateral pocket, twin loop, accidental arch, and tented arch.

Captain Barlow has reduced the scores of patterns ordinarily used by finger-print experts to twenty-seven, representing the whorls and more complex types. Finger-print systems generally are based on two peculiarities of ridges which appear on the outer joint of the fingers: first, they form into various patterns; second, fixed points, known as cores and deltas, are formed. Since all finger-print experts are familiar with plain loop patterns, Captain Barlow found it necessary to evolve a master chart showing only a few whorls, loops and arches to guide his men in tracking down prints.

"We found that prints from scenes of crimes were generally incomplete and indistinct," Captain Barlow told me. "In setting up a system of identifying single impressions we had to consider that portion of the finger which we could use to best advantage in classifying it, so we

Trap Master Criminals

confined ourselves to the cores and deltas found on the under side of the nail joint. From that small area alone we evolved our classification."

Lone prints, often invisible until powder throws them in relief, are left behind by many criminals—on the face of a filing cabinet, handle of a cooking pot, the rear-view mirror of an automobile, on a gun barrel, bottle, surface of a door, the edge of a window screen. From every conceivable surface they are reproduced by cameras and brought to the single finger-print file.

When a print is found, skilled officers immediately determine from which finger it originated. This is sometimes difficult, yet a simple formula, quickly applied, usually answers the question.

First, the position is considered. If very small, its size further indicates it to be a little finger. The slope of the ridges affords additional proof, for certain patterns, Captain Barlow has found, are unusual in particular fingers. Often two prints will be found close together, the relative positions indicating which fingers made them. For instance, the index finger will be shorter than the middle.

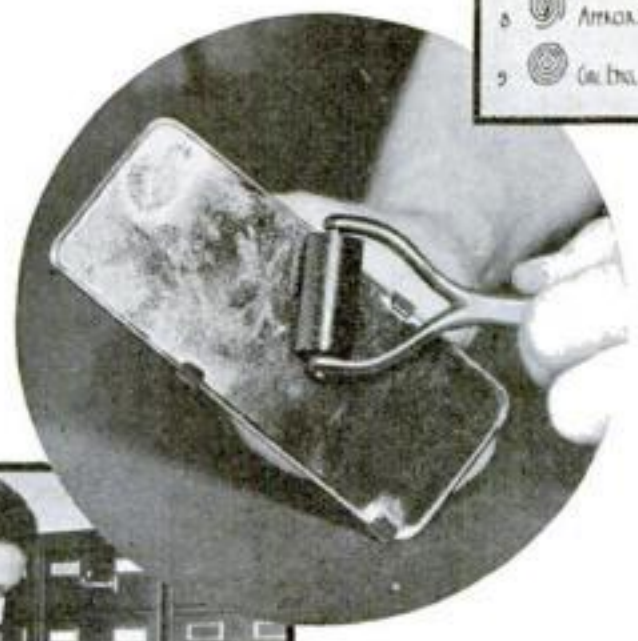
Identifications and convictions in single crimes are not full measures of the value of the single-finger system, for often identification of a single finger print has led to the clearing up of other crimes.

An epidemic of office burglaries recently swept over Los Angeles. In each the burglar climbed over the transom, broke down the metal support of the transom, wrecked cabinet drawers and took nothing but money. The culprit wore gloves and left no telltale prints behind.

Finally he slipped. On the front of a green cabinet drawer an officer found a print. Quickly he dusted it, photographed it and carried the negative back to police headquarters. An hour later a searcher started his hunt through the files of index fingers. In a few minutes he found an identical print, taken some months earlier from a safe-cracker in custody. A few hours later detectives brought in the suspect. Meanwhile search revealed that twenty-one offices had been similarly robbed. When confronted with this evidence, the burglar confessed to all twenty-one of the crimes that baffled police.

Though to untrained eyes one single finger print looks like any other, to the officers who see them daily, they take on definite personalities. Recently a burglar robbing a store left a thumb print on a small can containing money. When Captain Barlow examined the print under a magnifying glass, a criminal's name flashed into his mind. He went to the files, took out the print filed under that name and found them to be identical. He telephoned the detective bureau, saying, "Loren Harris did that job."

This master chart guides officers in classifying the thousands of prints on file. At top, an unusual print with its descriptive symbols



Above, preparing the rear-view mirror of an automobile for photographing a print. The print is dusted and the rest of the glass is blacked to kill the reflection of light

Left, the files that contain records of 50,000 single finger prints. Officers are comparing prints left by criminals with the recorded prints which have similar qualities

"Impossible," exclaimed the astonished detective. "He's in jail. I took him there myself last week."

When they checked with the jail, the detectives learned the culprit had escaped the day before. A few hours later, when arrested and confronted with his print, he confessed.

The success of the single finger print system depends upon matching prints found at the scene of the crime with those of known suspects, whose prints may be taken by investigating officers, or with those of known criminals whose prints are in the voluminous files. Identification may not come in a day, nor a year; but if the criminal whose carelessness left the greasy ridges behind is so unfortunate as to be arrested anywhere in the United States, his prints may eventually reach this quiet little room in the Los Angeles City Hall, where searchers soon will link him with the particular crime.

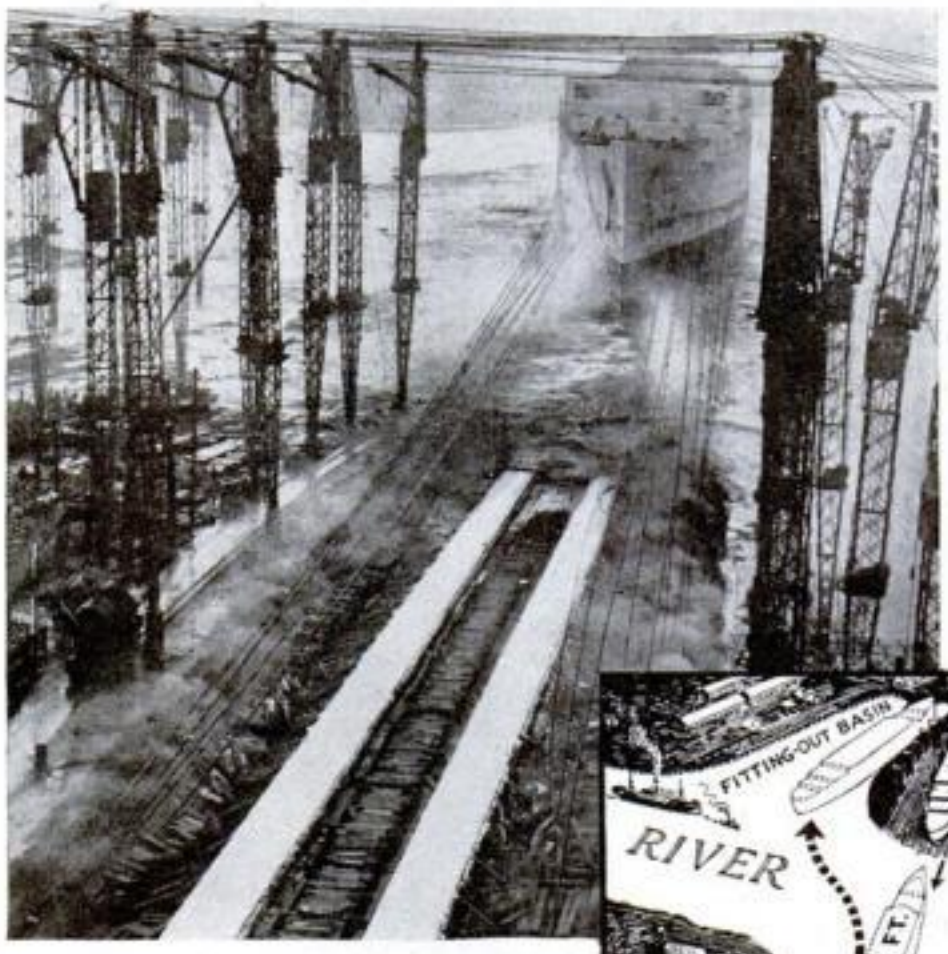
A bandit forced his way into a Los Angeles home, locked the husband in a closet, robbed the mother and killed the son. An hour later Captain Barlow commenced his exploration of the room. With his black and gray powders he dusted every possible *(Continued on page 124)*

Above, electric-eye watchman at safety gap in base of antenna tower. Right, arc across the gap

ELECTRIC EYE DETECTS LIGHTNING ON ANTENNA

LIGHTNING no longer plays pranks at WLW, Cincinnati, Ohio, superpower broadcasting station, where it formerly interrupted programs by striking the steel antenna tower and leaping a safety gap at its base. Once started, the arc was fed by the 500,000-watt transmitter and continued, draining the station's own power from the antenna into the ground. Now an electric eye cuts off power when an arc occurs.

CHAINS BRAKE LINER AT LAUNCHING

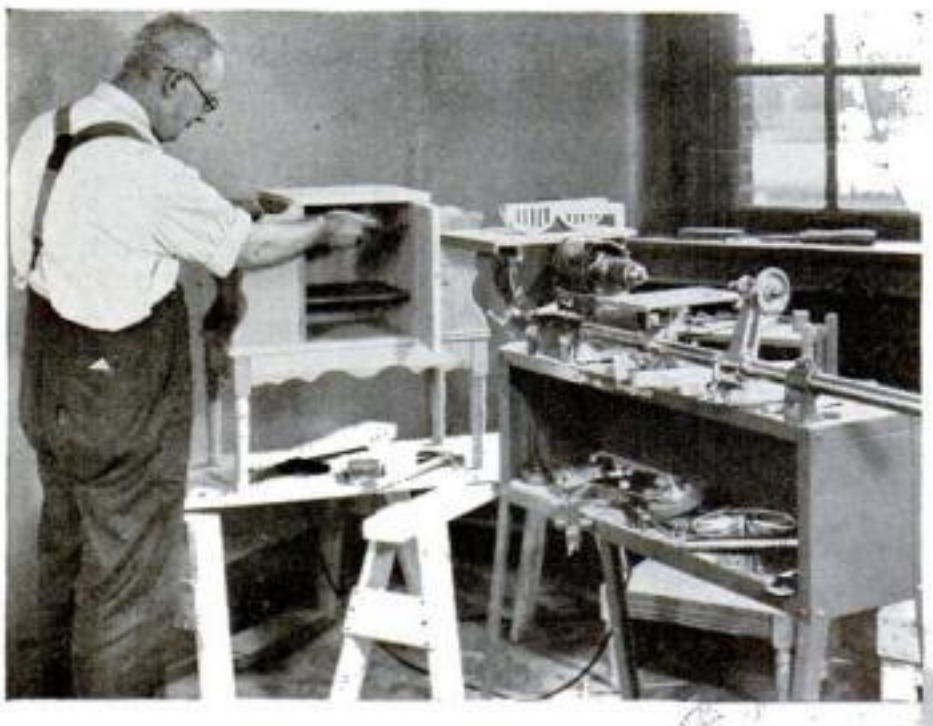


Left, unusual action picture shows the new British super-liner Queen Mary plunging into the River Clyde at its recent launching. The drag chains that checked the hull as it went down the ways can be traced in the cloud of dust

Below, drawing shows the problem presented by the narrow space in which the immense vessel was launched

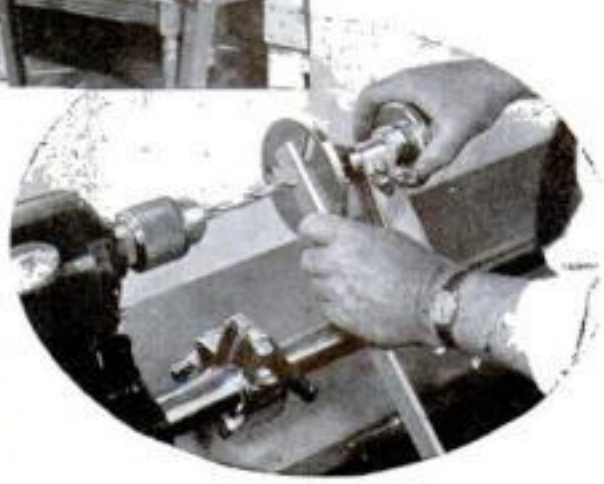
IN LAUNCHING the 1,018-foot superliner *Queen Mary* in a space barely large enough to float her mammoth hull, on the River Clyde in Scotland, engineers recently carried out a feat unique in shipbuilding annals. To accomplish it, they attached eighteen enormous drag chains to the sides of the vessel, to check its momentum as it entered the water. So well had the resistance of the chains been calculated that the great hull came almost immediately to rest, and was guided by tugs into the basin where its construction will be completed.

MOTOR WORKSHOP FITS SMALL SPACE



Left, the motorized workshop in use. It is equipped to turn brass and aluminum, saw wood, drill both metal and wood, and perform many other workshop operations

Below, drilling soft metal. The various attachments for the compact outfit are readily attached or detached as desired



So COMPACT that it can be stowed away in a box a foot square and a little over a yard long, a recently developed motor-driven workshop for the home is designed to do all sorts of operations in wood and the softer metals. The numerous attachments for the outfit are quickly attached by means of rapid-locking clamps and are removed as readily. Additional attachments may be built with the outfit itself.

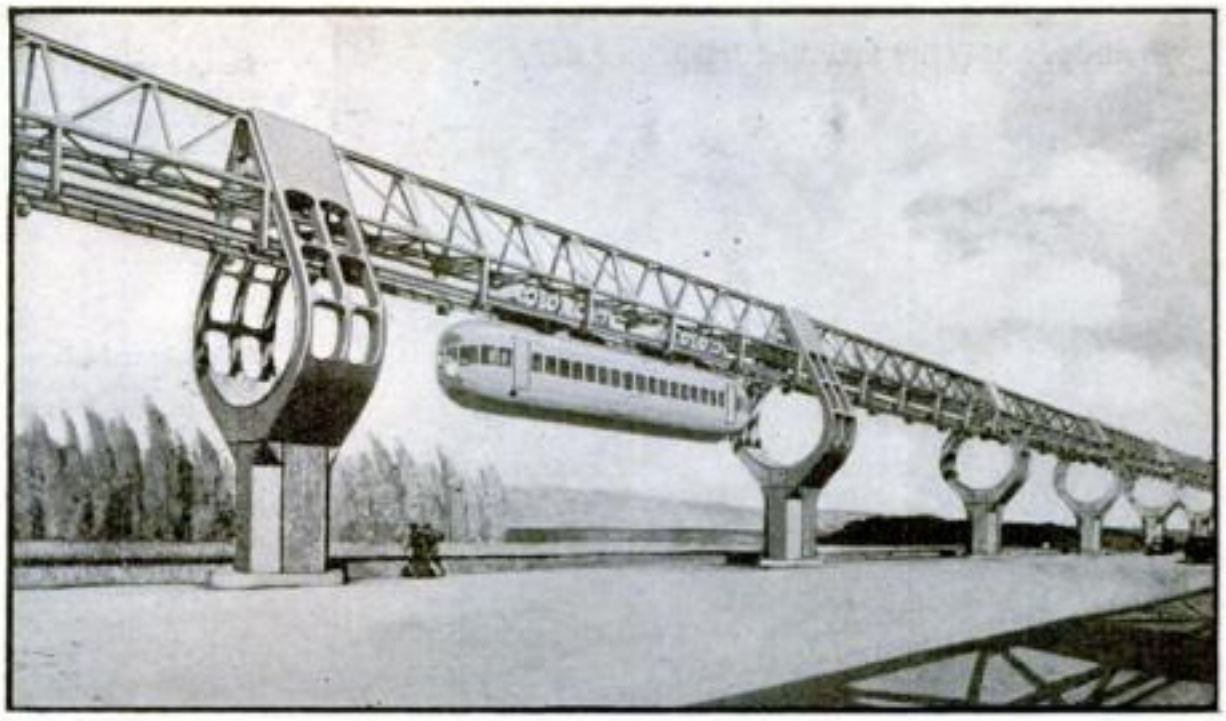
MACHINE TESTS PILOTS FOR QUICK THINKING

TO TEST the ability of airplane pilots, an unusual machine has been constructed at the U. S. Bureau of Standards. The pilot sits at a set of regulation airplane controls, facing a panel upon which colored lights are flashed. Each combination of lights represents a certain flying situation. The subject's twofold task is to interpret the meaning of the light signal and then to operate the controls as would be required in actual flight, while an automatic chronograph meanwhile records his reactions.

PEEP-HOLE SURF BOARD

WITH an ingenious "peep-hole" surf board, Sata Monica, Calif., lifeguards find lost yacht anchors and objects lost by bathers. A well in the board, covered at top and bottom with plate glass, permits a view of the ocean bottom.

AIR TRAMS MAY SOLVE BRIDGE PROBLEM



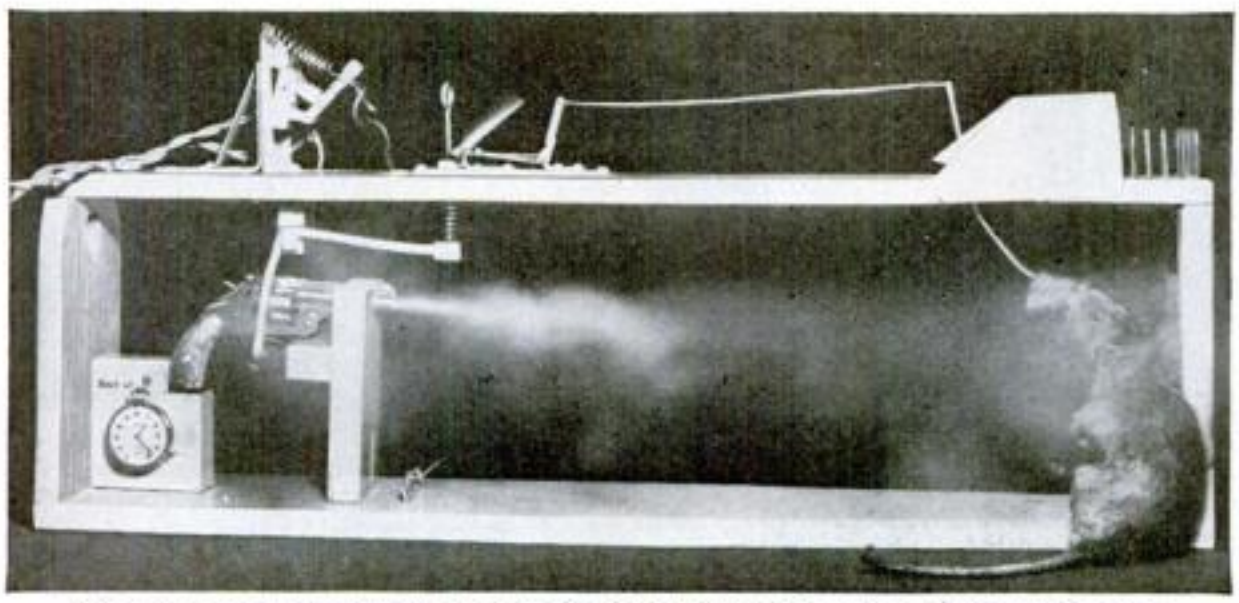
CARS speeding through the air at 100 miles an hour are offered by Joseph B. Strauss, chief engineer of the Golden Gate Bridge, as a solution of the San Francisco traffic problems likely to arise from the construction of the Golden Gate and Bay bridges. The aerial cars, as shown in the design above, would be suspended from multi-wheel trucks running on a overhead track. The track would be supported by a single row of columns formed in loops at the top to permit the passage of cars. The construction would give perfect safety, the designer claims.

FAST CAMERA REVEALS HOW BIRDS FLY

THE secret of a bird's ability to gain altitude rapidly was revealed recently by a high-speed photograph of a mourning dove snapped with an exposure of one fifty-thousandth of a second. Operated by engineers of the Massachusetts Institute of Technology, the lightning-fast camera caught the dove just at the moment of take-off, and showed that on the rapid downstroke of the bird's swing both the primary and secondary feathers overlapped, preventing the passage of air through the wing so that the bird can exert maximum lifting power. On the upstroke they let the air pass through.

TRAP SHOOTS RAT AND TAKES PICTURE

NOT satisfied with a conventional rat trap, a Syracuse, N. Y., photographer has built himself one that shoots the animal, takes a picture of the shooting, and records the time. By pulling a baited wire, the rat trips the trigger of a revolver that ends its career. The shot severs a string attached to a spring-operated electrical contact, setting off a flash-light bulb. A camera left in the dark with shutter open takes the picture, and a watch hung on the trap shows the time at which the shooting occurred.



The pistol shoots the rat and also sets off a flash-light bulb to take a picture of the event

Above, scout plane with hook for contact with airship. Right, the insignia worn by the planes

COMIC INSIGNIA MARKS MACON'S SCOUT PLANES

A PAINTED design showing a pair of acrobats swinging in mid-air decorates the fuselage of each of the tiny scout planes attached to the U. S. Navy airship *Macon*. The insignia caricatures the method by which the planes make contact with the mother ship in flight, through a hook on the plane that engages a trapezelike bar suspended beneath the airship. A scrawny aerialist represents the scout machine, and a portly one the huge bulk of the mother ship, *Macon*.

INVENTS TONSIL BRUSH

BRUSHING tonsils night and morning to clean and disinfect them, as a substitute for their surgical removal, is recommended by a London physician, Dr. D. Findlay. He has invented a special tonsil brush to be used for this purpose.

RIVER TUBE REPRODUCED FOR MOVIES

Left, interior of the movie reconstruction of the East River tunnel. It is being used in a film showing the building of the tube

Below, how the dummy tunnel looks on the outside. It is fitted with locks and other working parts, and the tools used are real

AN exact reproduction of New York City's East River tunnel between Manhattan and Brooklyn, measuring 425 feet long and seventeen and one half feet in diameter, has been constructed on a Hollywood movie lot. Locks built at the shore end, duplicating to scale those in operation on the original tunnel, operate during the filming of "East River". Shield, working platforms, muck holes and erector arms at the working end of the tunnel also are practical, so as to show actual work of construction during the picture. Much of the apparatus used was shipped west from tunnel jobs on which it was employed.

Designed like a carpet sweeper, this new lawn cleaning device picks up all leaves and loose rubbish lying in its path

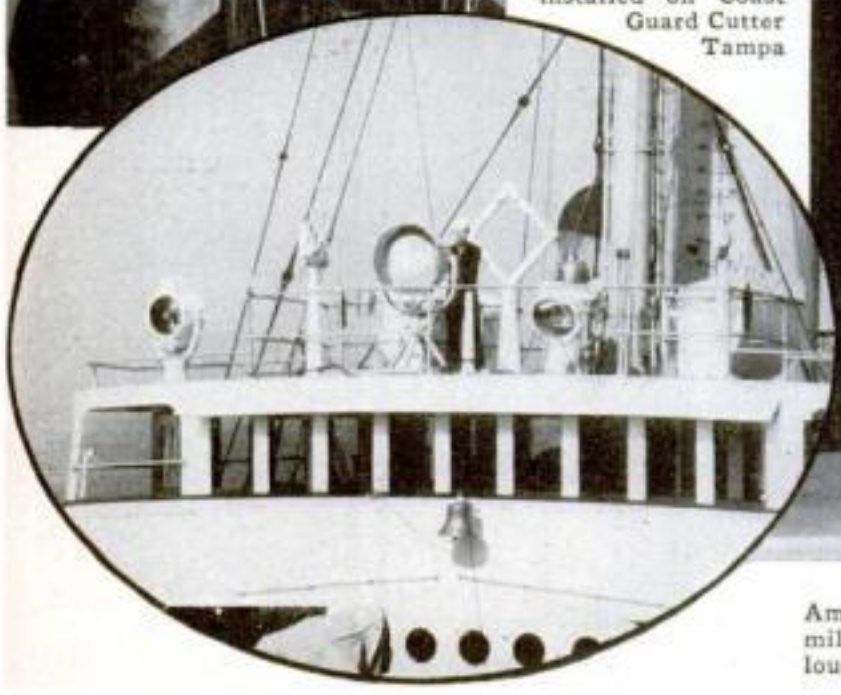
LAWN SWEEPER PICKS UP LEAVES AND RUBBISH

SWEEPING up leaves, instead of raking them, is made possible by an odd hand machine introduced in England. Pushed across a lawn, it operates on the principle of a carpet sweeper, depositing leaves and litter in a capacious hopper at its rear. The new method, shown in the photograph above, is said to be both convenient and time-saving, especially for parks and large estates where large areas are cleaned.

LOUDSPEAKER HAS VOICE OF THUNDER

SO POWERFUL that its stentorian voice can be heard miles away, a monster loudspeaker developed by Western Electric engineers amplifies the sounds of human speech 1,000,000 times, or to a volume that is louder than a clap of thunder. The big horn was installed aboard the Coast Guard vessel *Tampa*, during the recent international yacht races, to issue instructions to spectator craft. Other predicted uses are to direct mass movements of crowds or soldiers, to issue orders to firefighters, and to bellow instructions during a sea rescue. It sacrifices naturalness of reproduction to concentrate its energy on voice frequencies that are most plainly understood.

Left, talking over the big loudspeaker. Below, instrument installed on Coast Guard Cutter Tampa



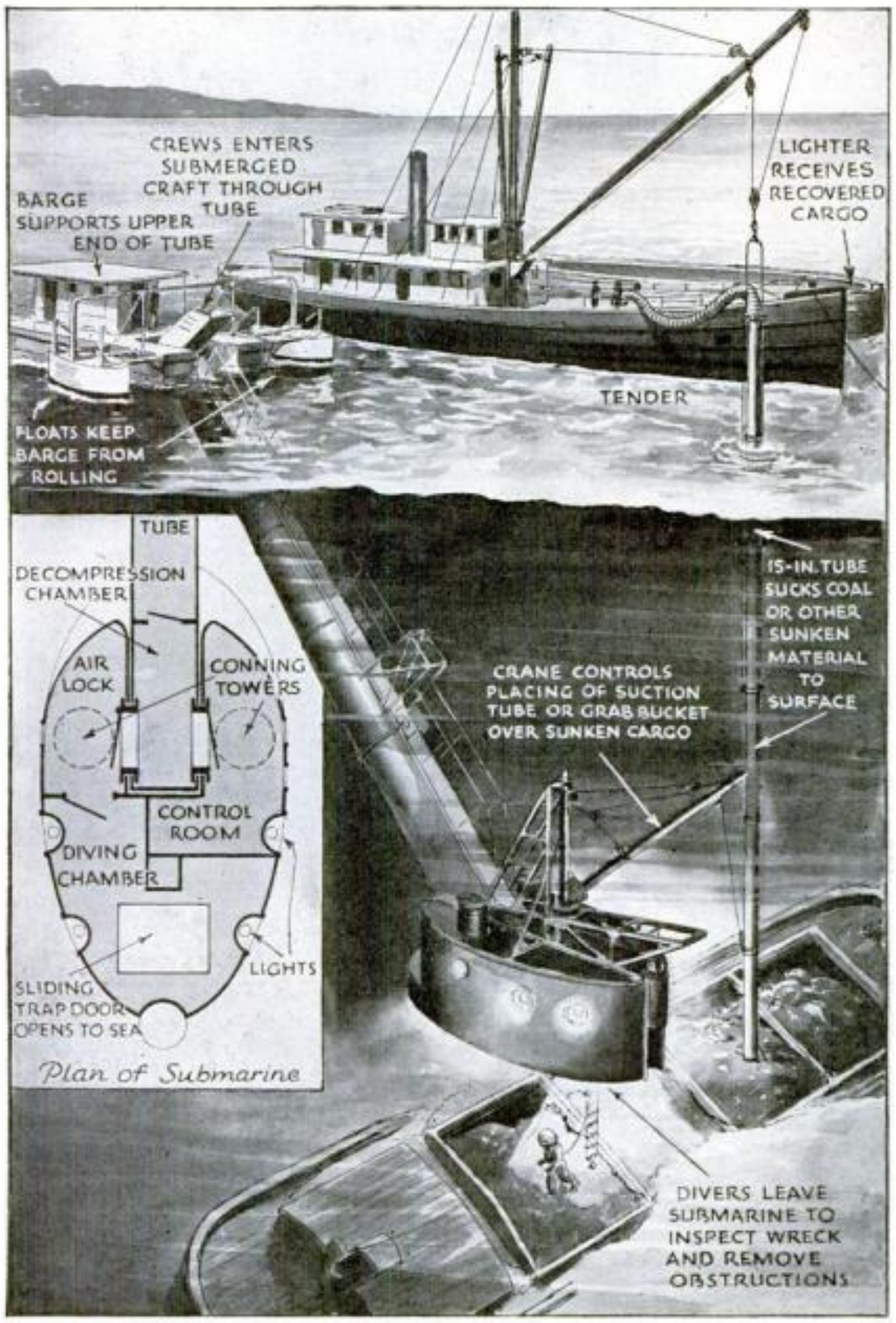
Amplifying the human voice to one million times its volume, this new loudspeaker can be heard for miles

ROBOT PLAYS ANY TUNE ON SPOKEN COMMAND

A ZITHER-PLAYING robot completed by a San Francisco dentist, after seven years of work, has a repertoire of 3,000 different airs. According to its maker, it executes any one of them upon a spoken command. The voice is picked up by resonators and sets in motion a complicated electrical mechanism, causing the hand of the automaton to pluck the desired strains upon the strings of the instrument. A part of the machinery is housed in the hollow interior of the figure, which is carved from wood, and the remainder in a chest upon which it reclines, as shown in the picture above.

Pumping Cargoes from Sunken Ships

Submarine Builder Designs Unique Vessel for Bulk Salvage Work



Artist's drawing shows how the strange craft designed by Simon Lake, pioneer submarine builder, will appear when in actual use to salvage bulky cargoes from submerged vessels

supplies air for the divers through a huge tube nearly 150 feet long. When the submarine chamber is submerged, the crew and divers enter it by descending the tube, which then inclines at an angle of about sixty-five degrees. An elevator, consisting of a wheeled car running on a track, is provided for the purpose.

Passing through a door at the end of the tube, members of the crew enter a control room containing a panel of knobs and levers that operate the crane. Divers pass through another door into an air lock on the starboard side. Here they remain until the air pressure is increased to equal the pressure in the diving compartment.

The diving chamber is reached through a watertight door. When the submarine is submerged, air pressure in this chamber is maintained equal to that of the water outside, to prevent the water from flooding the craft when a sliding trap door in the floor is withdrawn. Divers step through this door directly upon the sea floor. Using comparatively short air lines, they can move about freely.

Under brilliant light furnished by five floodlights carried by the submarine, the divers clear obstructions so that the grabs or suction tube can reach the cargo. The vessel's crane, capable of swinging in a wide arc to either side of the craft, guides the buckets or tube to the desired spot.

Later on, the odd salvager is expected to be used for pearl and sponge fishing and for sinking wells into the rich gas and oil fields known to exist in many places beneath the ocean.

Tube through which divers will reach the ocean floor

DESIGNED for undersea salvage, a strange craft just launched by Simon Lake, veteran American submarine builder, combines the principles of submarine boat, floating crane and diving bell. A twenty-two-foot-long submarine chamber, forming a part of the vessel, can descend to a maximum depth of about 100 feet. It will first pick out a submerged hulk with its powerful lights and then drop divers directly upon it. Finally, by means of its electric crane, it will guide grab buckets or a suction tube lowered by surface tugs to raise the salvaged cargo. Unlike most salvagers, the vessel will not concentrate upon gold and other precious metals, but with the aid of the suction tube will attempt to pump up coal and other bulky materials.

The surface portion of the vessel resembles a barge and carries a powerful compressor which

Submarine chamber of the salvage vessel, showing the ports for the powerful floodlights

Wins World-Wide Fame

Perfected Technique in Use of Camera and Lens Enabled Amateur to Make Photomicrographs That Surpassed Those Made by Leading Professionals

By EDWIN TEALE

ONE evening, seventeen years ago, a friend called at the home of Philip O. Gravelle in South Orange, N. J. He was starting on a vacation and wanted to leave a microscope for safekeeping. Gravelle, who was nearly forty, had never looked through a microscope in his life. It was like putting on magic glasses. That instrument, left by chance at his door, started him on the hobby of a lifetime.

Today, at fifty-five, he has won world-wide honors in microscopy. He has been made a Fellow of the Royal Microscopical Society, a Fellow of the Royal Photographic Society, and is the only man in America to win the coveted Barnard Medal of the London Photomicrographic Society. He is the originator of the comparison microscope method of tracing bullets to the guns that fired them. He has played a pioneer role in applying the microscope to industry, criminology, and advertising. And he has accomplished all this in spare hours and odd moments, pursuing his hobby when the regular day's work was over and he sought relaxation.

His laboratory, built at the back of his home in South Orange, is probably the finest private workroom of its kind in existence. It is the dream of a hobbiest come true. Rows of instruments, cabinets of slides, shelves of auxiliary lenses, batteries of cameras, lights of a dozen kinds pack the room in orderly array. They represent almost every conceivable aid to fine work.

In this paradise of the amateur microscopist, I recently spent the better part of a week-end watching Gravelle at work. A tall, spare man with graying hair and mustache, he adjusts lights, focuses cameras, snaps shutters to record on film a strange, mysterious, fascinating world that lies beyond the reach of human eyes.

The tip of a snail's tongue, blood corpuscles battling an infection, colloid particles vibrating in a film barely one ten thousandth of an inch thick are among the wonders he photographs.

Often he takes the same picture over and over, as many as twenty times, to get it exactly right. He works carefully, methodically, scientifically. He keeps a written record of everything he does. Each negative has a number and on the filing envelope in which it is kept, as well as in a master book, he places complete data on the camera, the microscope, the light, the film, the filter, and even on the paper and developer used to produce the final print. Any other microscopist, following this data, can produce the same results.

Behind his laboratory, Gravelle has a

Above, pollen of hollyhock magnified fifteen diameters. Left, silk crepe showing how water drops act as lenses to magnify the fibers

Above, Gravelle's photomicrograph of rayon material, the threads magnified thirty diameters

IDEAL HOME FOR A HOBBY

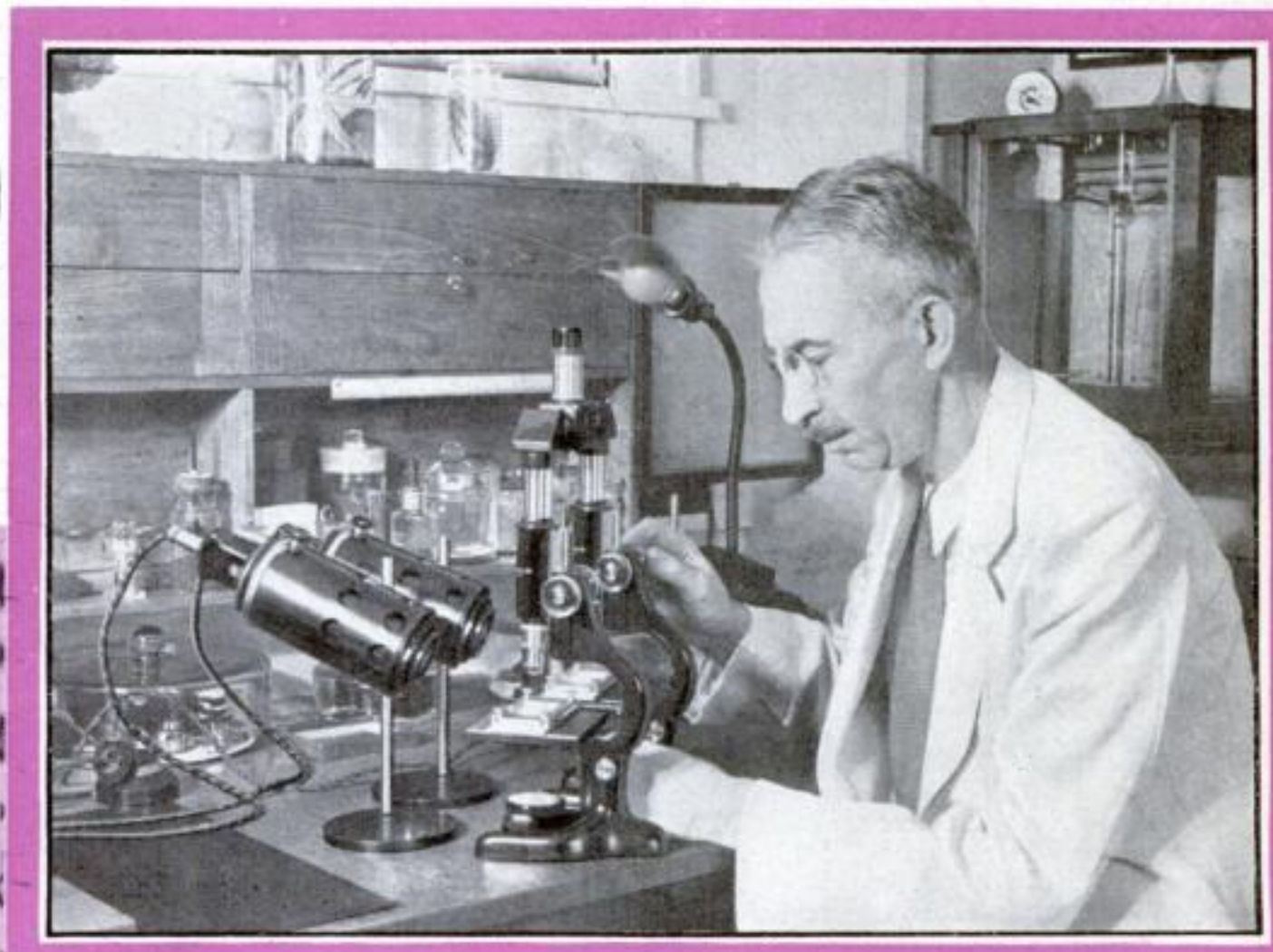
Above, exterior of Gravelle's laboratory at the rear of his home. In the foreground is the pond where he gets many specimens. At right, interior of the laboratory with Gravelle and his assistant hard at work

Photomicrograph above shows the germs that cause sleeping sickness magnified about 1,200 diameters. This is one of Gravelle's most successful photos

with Microscope Hobby

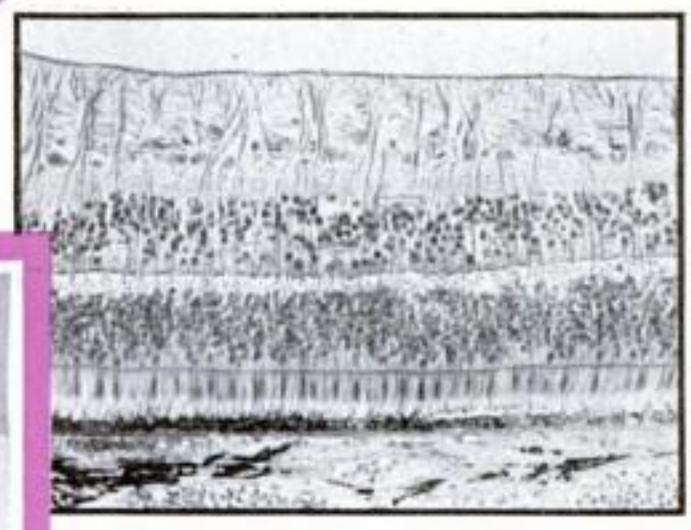
The figure of the photographer can be seen reflected in this enlarged picture of a rat's eye

Greatly magnifying a section of the proboscis of a blowfly, this remarkable picture was made in the Gravelle laboratory



Here is Gravelle with his comparison microscope. He originated the methods of using such an instrument to compare scratches on bullets and trace them to the gun from which they came

With this special photomicrograph camera, which he designed, Gravelle is able to focus on an object while looking through the side



With a magnification of 125 diameters, the camera caught this view of an eye's retina

pool dotted with lily pads. It supplies an almost endless stream of exciting adventures. From its water, he fishes delicate organisms that expand under the microscope into fantastic creatures or plants of a thousand weird designs; into living threads of thin green algae; into blue-gray flowerlike Plumatellae; into strange cigar-shaped Pinnulariae, plowing through microscopic debris like submarines.

One morning he found the water of the pool a brilliant green. At first, he thought it was filled with pollen from overhanging trees. But his miscroscope revealed it was teeming with a new kind of protozoa.

On the yellowing pages of a large record book, Gravelle has penciled notes that go back to the very first object he photographed. It was a drop of blood magnified 500 times. While his friend was away, he hitched an old view camera to the microscope and, using a gas lamp with an inverted mantle for illumination, took his picture. The exposure lasted three minutes. Today, with modern lighting, he obtains a similar photomicrograph in as many seconds.

By the time his friend returned, Gravelle was poring over microscope catalogs, choosing an instrument of his own. During the months that followed, he added to his equipment, swapping apparatus, picking up second-hand instruments, purchasing new aids to his engrossing hobby. His tip to beginner is to avoid second-hand microscopes unless you have a friend who knows lenses and will help you.

Ever since he was fifteen, Gravelle has been interested in photography. One of the most prized possessions of his laboratory is an original Daguerreotype camera, complete with fuming box and chemical bottles, which dates back to within fifteen years of the beginnings of photography. Another relic of the early days is a Whalmsley "Handy." It was made in 1894 and was one of the first cameras used in taking photomicrographs.

During his education at Columbia University and Pratt Institute, Brooklyn, N. Y., his interest in camera work led him to specialize in chemistry. After he had become a designer of textile patterns, with offices in New York, he continued his hobby, concentrating on landscape and color pictures. This photographic background has been of immeasurable aid in making snapshots of the invisible.

The early pages of Gravelle's record

Gravelle exhibits here a genuine Daguerreotype camera with fuming box and chemicals

book are filled with a curious list of things he photographed: the kidneys of a cat, the blood of a frog, the fronds of invisible plants floating in a drop of water, fleas, molds, pollen. Everything was new and fascinating. He was a scientific Gulliver exploring a land of Lilliput.

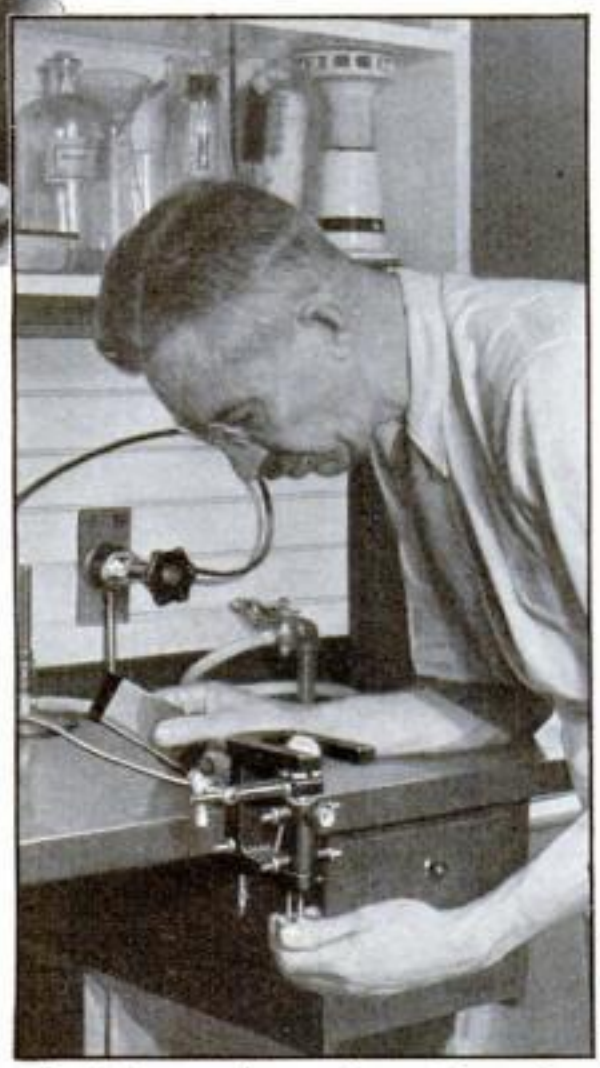
A few months after he had taken up his hobby in earnest, a paint manufacturer in Newark heard of his photomicrographs and brought him his first paying job. It was taking magnified pictures of pigment particles. As the covering power of paint depends upon the size of the pigment particles, the manufacturer wanted to know how long he would have to grind pigment to reduce the particles to a certain size. Gravelle's photomicrographs told him and the check he sent in payment immediately went into the purchase of new equipment. Like a farmer plowing in fertilizer, Gravelle has continually plowed in the profits from his pictures to obtain new and better apparatus.

Many of the pictures of magnified objects you have seen in the advertising sections of leading magazines have come from Gravelle's home laboratory. One, illustrating the way shaving cream fills the spaces between the hairs of a beard, was run ten years ago and found to be such an effective display it was revived again this year. Gravelle was one of the first to take highly enlarged pictures of the cutting edge of a razor blade, showing how the beard nicks and chips the steel.

As a pioneer free-lance microscopist in industry, he has produced magnified pictures of silk, tobacco, soap, yeast, coal, milk, metals, pencils, pens, razor blades, mayonnaise, cod liver oil, ink, and a host of other commodities. He has helped turn out better newspapers by showing how the crystals cool in stereotyping plates and how the ink soaks into various kinds of paper. He has aided in textile manufacturing by revealing what happens to fibers in various weaves of cloth. In all, he has taken pictures or helped solve problems for more than 100 American concerns.

Once a silk manufacturer asked him to photograph the initial steps of a run in a stocking. The tiny, subvisible breakages revealed by his photomicrographs helped the company turn out better stockings. In another instance, one of his pictures which magnified 2,000 times curious, pollywoglike particles in a rubber composition, played a big part in winning a million-dollar lawsuit. On several occasions, discoveries made in his laboratory have resulted in the introduction of new products or the altering of old manufacturing methods.

A few years ago, for example, a producer of plaster of Paris came to Gravelle with a mystery he couldn't solve. For nearly a dec-



As the first step in preparing specimens, Gravelle freezes them in this apparatus. Then they can be cut in slices unbelievably thin

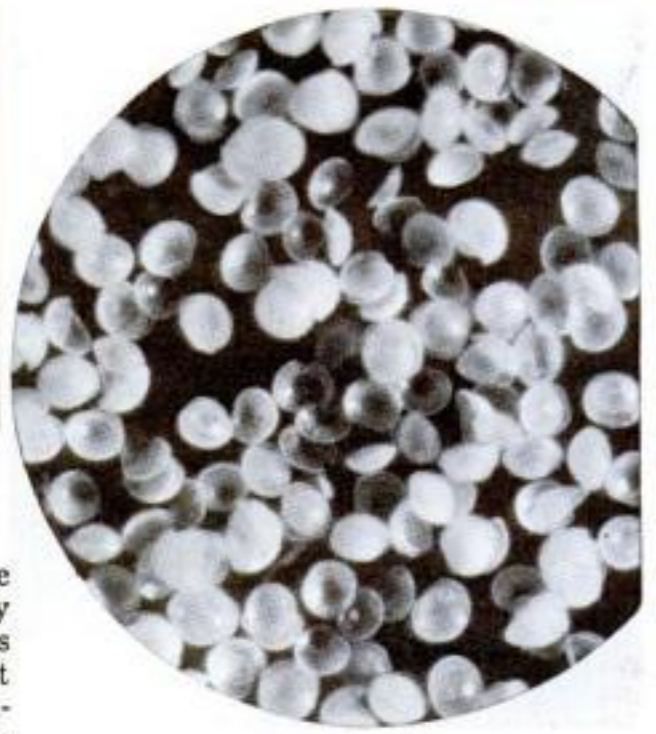
ade, his product had been a leader in the market. Then the public had suddenly veered to a rival's brand. Experiments showed that it set more rapidly. Yet chemical tests revealed both plasters contained exactly the same ingredients. Gravelle adjusted his microscope, focused his camera, snapped his shutter and solved the mystery. The rival manufacturer was simply grinding his plaster into finer particles. By an easy alteration in factory methods, his client was able to restore his product to its former favor.

Among the thousands of photomicrographs you see on file in Gravelle's laboratory is one remarkable picture revealing how plaster of Paris sets. It shows clearly the mass of interlocking crystals that hold the plaster together. Another unusual print demonstrates the way a drop of water may act as a magnifying lens in miniature. It is a photomicrograph of raincoat material, the fibers under several waterdrops appearing with added magnification.

At the time he was thus helping provide industry with a new eye, Gravelle was also engaged in an even more exciting adventure. In 1925, he joined with Charles E. Waite, John H. Fisher, and Col. Calvin Goddard, in establishing the Bureau of Forensic Ballistics, pioneer organization for tracing bullets to the guns that fired them by comparing the scratches on the lead left by the barrels. The technique he worked out, as the microscope expert of the bureau, is now used by scientific criminologists throughout the world. As an eloquent silent witness, his photomicrographs have figured in a number of celebrated murder cases, not only convicting the guilty but saving the innocent as well.

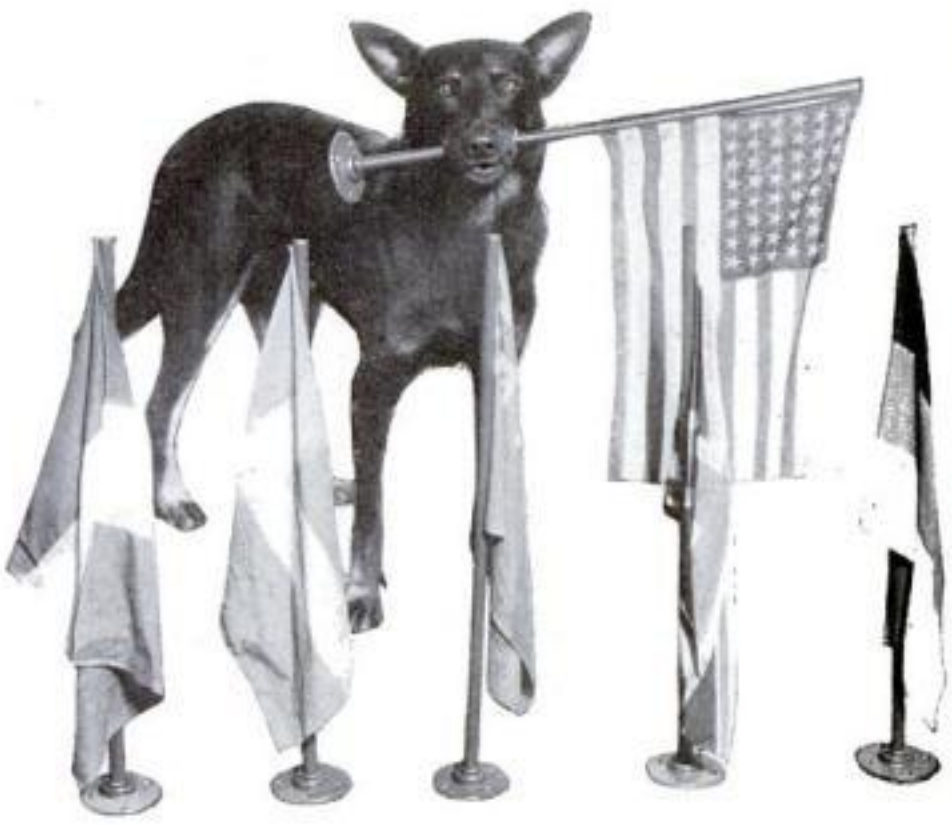
Because a single variable element would upset the scientific accuracy of his photomicrographs and make it impossible for him to achieve the same results every time, Gravelle coöperated, several years ago, with engineers of the General Electric Laboratory in producing a new kind of lamp. The old arc light he used sometimes varied in intensity so he suggested a ribbon filament tungsten lamp that would overcome the difficulty and always provide the same intensity of light.

On several occasions, his home workshop has been turned into a movie set where actors too small to be seen by human eyes performed their parts. One reel, which has since been released as a teaching film, recorded the life cycle of the rotifer, that strange, subvisible dweller in stagnant ponds. Another made for a manufacturer of surgical sutures, depicted the thrilling drama *(Continued on page 116)*



Top circle, young oysters as they appear in a photomicrograph when enlarged thirty diameters. Above, magnified wing of a butterfly showing shinglelike structure of covering

Dog Learns To Spell and Cipher



Joe can pick out the flags of a half dozen nations, in any order they may be named. This trick is especially interesting in view of the opinion prevailing among experts that dogs are color-blind

ON STATEN ISLAND, N. Y., a black-and-tan German shepherd dog is now learning to write his name with a piece of chalk. Experts say that writing is beyond the power of canine intelligence. However, this particular dog, Joe by name, has already upset some of their pet theories by learning to read, spell, distinguish colors, and solve problems in arithmetic.

Joe's owner, Frederick S. Forde, has trained him solely as a hobby. At first he had no idea of teaching the dog anything beyond the rudiments of good canine conduct, but Joe learned so readily that Forde kept on. Today, at five years of age, Joe has mastered enough mystifying stunts to hold an audience spellbound for an hour.

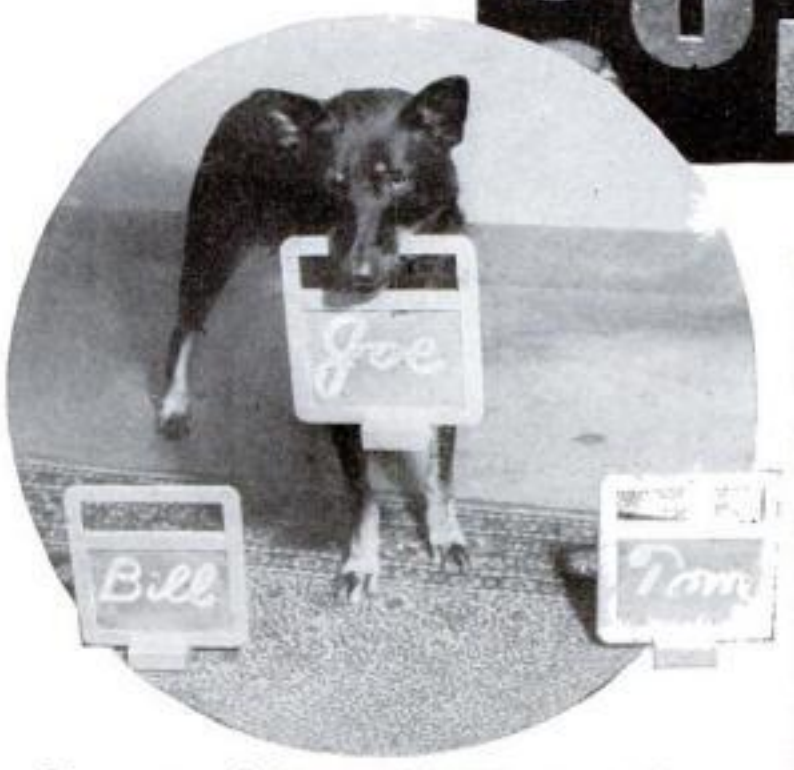
The dog's specialty is arithmetic. At a word from Forde, Joe places his fore-feet on the edge of his counting box. So that he cannot catch visible signals, a pair of goggles with painted lenses is put over the dog's eyes, and to make sure that he will not get a cue from his master's voice, the skeptical visitor is asked to put the questions.

One after another the questions are fired. Joe is asked to multiply three by six and then to subtract eight. Promptly, Joe places a forepaw on the bell clapper in the box and rings the bell ten times.

Written problems are presented by placing painted numbers and arithmetical symbols on an easel. Joe is required to multiply nine by six and to subtract eight. With only a casual glance at the board, he taps out the answer with unfailing accuracy.

From a full alphabet in wooden block letters strewn on the floor Joe will pick out his name, one letter at a time, either forward or backward. He can also recognize his name when it is written on a slate.

The dog spells out his own name in block letters. Below, he wears a blindfold while tapping out the answers to problems in arithmetic



From a group of slates on which different words have been written, Joe chooses the one bearing his name

Joe also does a bit of conjuring. Forde makes a fan of a deck of cards and asks the visitor to choose one, cautioning him not to touch more than one. The card selected is returned to the deck, which is placed in a box and shaken up. Joe noses about among the jumbled cards and invariably brings up the proper one.

The ease with which Joe can tell one color from another is astonishing in view of the common belief in the color-blindness of dogs. He will pick out the flags of a half dozen nations in any order his owner names, and does another stunt in which he uses disks that are unmarked except for their color. He has been taught only a few police tricks but he can scale a thirteen-foot wall, disarm a man and guard his prisoner by knocking him down and refusing to let him rise.

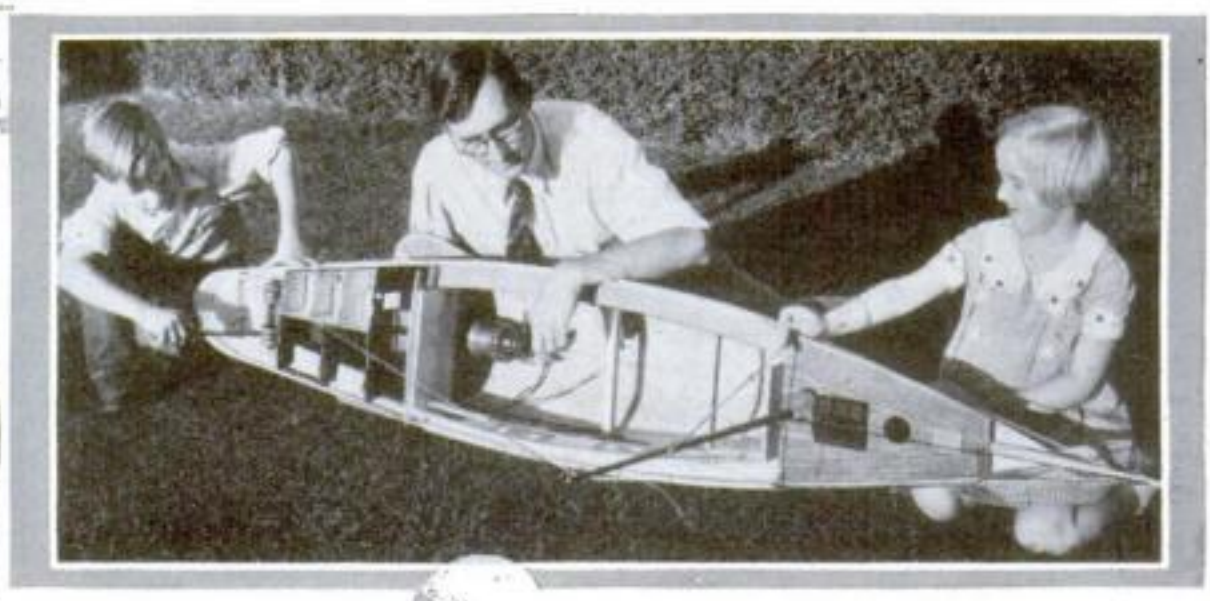
Family Joins in Model-Making Hobby

Manual-training instructor and his children enjoy fascinating spare-time work on miniature railways, vehicles, and buildings

Left, a gas-electric train that runs around the Howards' flower garden. A thirty-two-volt motor powers it

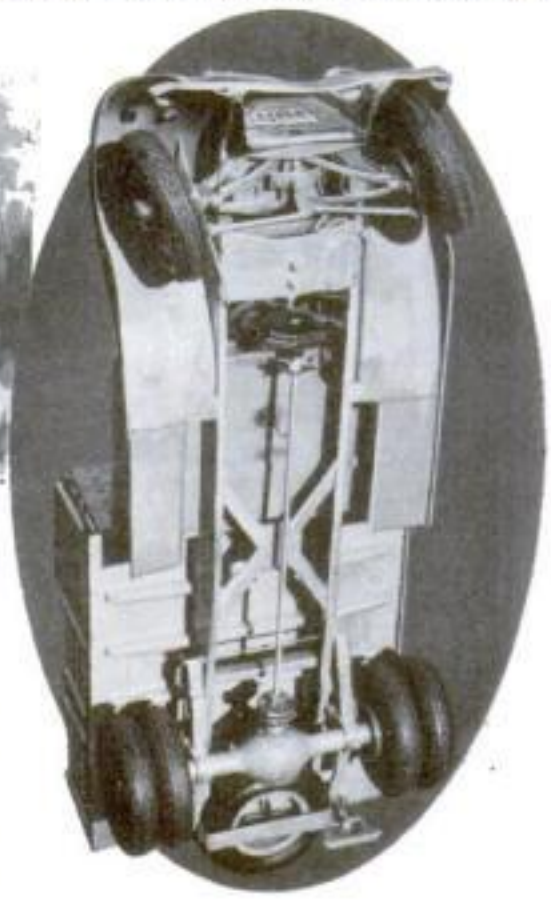
TWO California children, Dick and Laurel Howard, may well be envied by other boys and girls, for they have playthings the like of which cannot be enjoyed by even the wealthiest. Their father, an instructor in manual training in the high schools at Pomona, in his spare time builds models ranging from cardboard reproductions of historic California missions, to a miniature railway complete with bridges, tunnels, and stations, which meanders through his flower garden. Howard started model making several years ago when his pupils demanded information about the workings of mechanical and electrical devices. Soon he was constructing models of many kinds. Aided by his son and daughter in the simpler parts of the work, he has recently produced an automobile truck with free wheeling and knee-action front wheels; a Diesel-type yacht controlled by radio; interurban cars and railway trains, and a model New England village from whose tiny lighted church on Sunday evenings sacred music is heard through the medium of a small radio.

Below, a model truck that has both free wheeling and knee action. It operates on a storage battery or on household current



Dick and Laurel Howard help their father to finish a radio-controlled Diesel-type yacht. It is steered and maneuvered from the shore

This model of a typical New England village contains the familiar red brick schoolhouse, church, general store and post office, and even a water wheel. The buildings are lighted, and a tiny radio receiving set concealed in the church picks up sacred music of Sunday night broadcasts. Other model structures include a Spanish mission



Right, a bottom view of the model truck. Weighing thirty pounds, it duplicates most of the mechanical features found in real automobiles

If the old miner who formerly owned this shack at Virginia City, Nev., had looked beneath it, he would have been made rich. Instead, he sold it and moved away, leaving the new owner to discover that the dilapidated cabin rested on a rich vein of gold ore. The picture shows a shaft that was dug under the house

Theodore Jones, left, and Henry Grob, of Baltimore, Md., with part of the $11,000 in old gold coins they found while digging a hole in the floor of the cellar of the Jones home. It is not known at this writing whether they may keep their find

FORTUNES in Back Yards

TWO Baltimore lads, digging a hole in a cellar not long ago, unearthed a pot holding $11,000 in old gold coins. Many others have found unsuspected riches at their doorsteps. One man discovered under his home a coal deposit which now supplies him with fuel. Another drilled a hole in his back yard and struck a miniature oil gusher. A third tripped over a stone on his farm and found it to be almost pure silver. Victim of an ironic turn of fortune was one old Nevada miner who sold his house. The new owner discovered that the cabin rested on a gold vein assaying $500 to the ton!

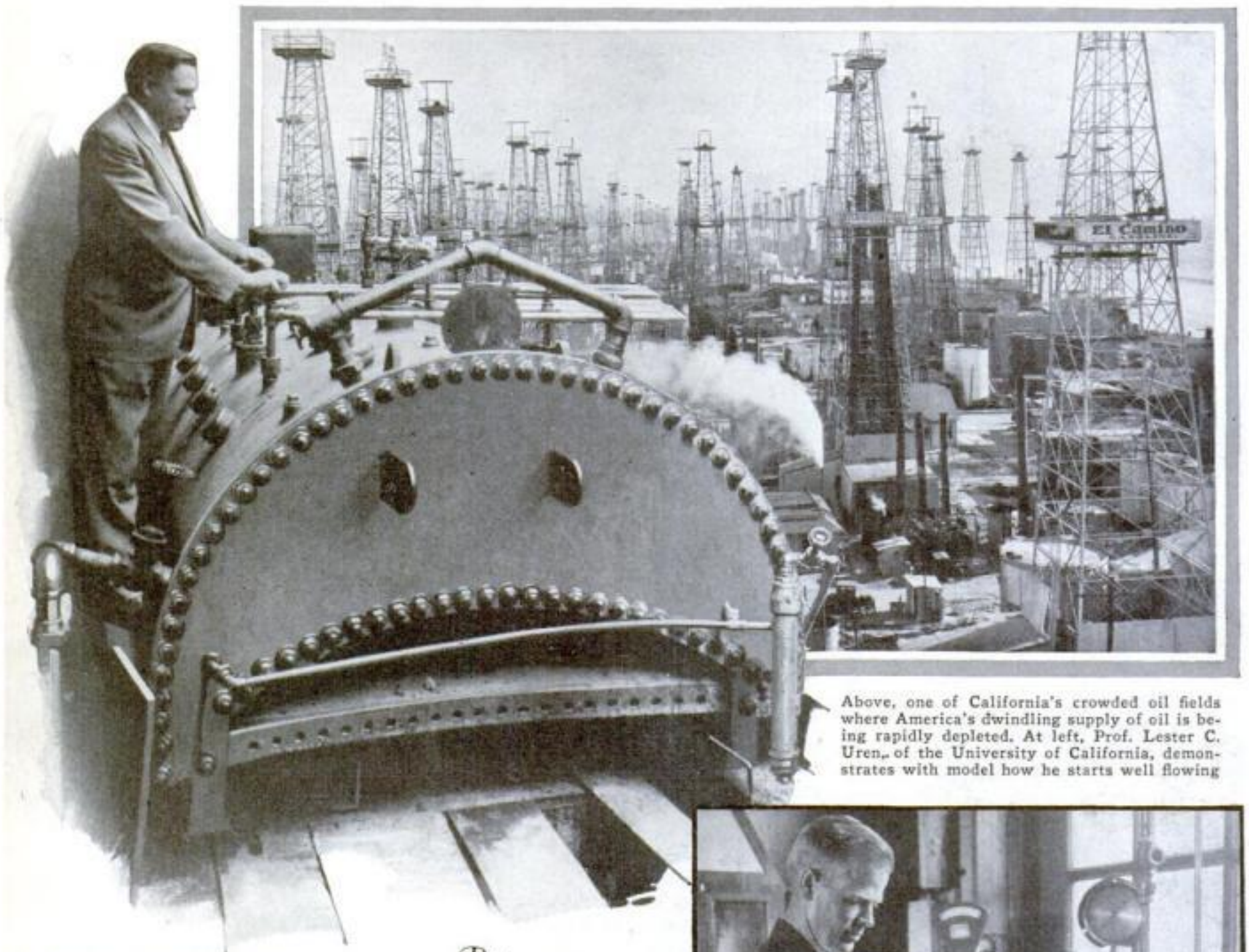
Drilling a well for water, a man at Libertyville, Ill., struck a pocket of natural gas instead. The photograph shows the owner pointing to the pressure gage. He planned to pipe gas into his home

Russell Crocket, a high-school boy of Neodesha, Kans., drilled a hole in his back yard with a post-hole auger and struck oil. The success of his first well inspired the amateur oil man to drill two more of them

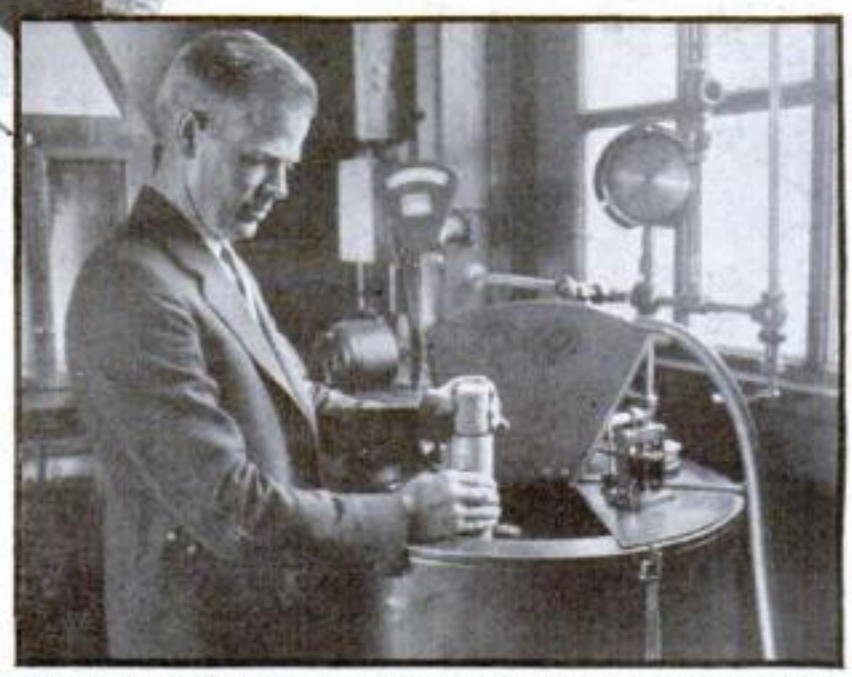
Left, an oil well in the back yard. Unexpected wealth came to the owner of this property in Kansas City, Kans., when the laying of a gas main revealed the presence of oil. The drilling of a well brought in a flow of thirty barrels of oil a day

Walter Riebling, of Overbrook, Pa., need never worry about fuel bills. When his coal bin is empty, he has only to take a pick and shovel into his private coal mine underneath the house and dig a supply, as shown in the photo at the right

Earth's Last Drop *of* Oil



Above, one of California's crowded oil fields where America's dwindling supply of oil is being rapidly depleted. At left, Prof. Lester C. Uren, of the University of California, demonstrates with model how he starts well flowing



By forcing oil into a core enclosed within a steel barrel, Prof. A. J. Carlson, of the University of California, shows how he is able to determine the permeability of sand that contains oil

By
ROBERT E. MARTIN

FULLY 100 billion barrels of oil, now hidden in the depths of the earth, have been added to the nation's wealth by new discoveries made in a baby oil field and miniature oil wells, where a novel tube, representing a section of sand at the bottom of a typical well, has been successfully used.

Professor Lester C. Uren of the University of California petroleum engineering faculty, working with other research scientists, has solved problems which long disturbed oil men who saw the United States' oil reserve rapidly dwindling. He and his associates have found in their laboratories means of giving new life to depleted fields, and thereby have added fully a half-century's supply to the fifteen-year supply available by present methods.

To date sixteen billion barrels have been drawn from American wells. In untapped fields ten billion barrels are known to be ready for the drill. Since Prof. Uren's researches with the small models of producing units and other data from the field and laboratory demonstrate that underground pressure and pumping bring to the surface only one twentieth to one fourth the total supply, there remain some 114 billion barrels of liquid gold in American fields, including 104 billions now added to Uncle Sam's known oil endowment.

But oil that cannot be brought to the surface is worthless, so petroleum technologists, working in the field and in several laboratories, have found ways to revive worn-out fields and conserve new ones which promise to result in a yield of from two to three times the quantities originally withdrawn, and in some instances the recovery may equal four fifths of all the oil known to exist around a well.

Of all the oil that has been wrested from the earth, nearly two thirds has come from the United States. In recent years this country has supplied almost three fourths of the world's petroleum needs. With only a fifteen-year visible supply promised by present methods in present known fields, engineers have been battling for new information on fundamental problems which could be turned to practical account in the oil fields.

In the University of California petroleum laboratory, I saw enacted on a small scale the experiments which led the engineers first to understand conditions beneath the earth's crust, then enabled them to prescribe ways and means of forcing new crops of oil from reservoirs no human eye has ever seen.

Ten times Professor Uren pumped natural gas under high pressure into the miniature oil field and ten times oil flowed through pipes representing full-sized wells. Each time less oil emerged from the tightly packed sand, yet following the tenth flow nearly half the amount placed orig-

Sought by New Discoveries

inally in the steel tank had been forced out exactly as pressure forces oil from reservoirs under the earth's surface.

Near-by a mixture of oil and natural gas, under pressure as high as 2,600 pounds to the square inch, was forced into a twenty-foot steel tube filled with sand. Within this tube had been created on an actual field scale the conditions surrounding the bottom of a well in a high-pressure field. At intervals gages recorded the diminishing pressure, thus revealing how oil loses its pressure on approaching a well.

It is with these devices that Prof. Uren and his colleagues reproduce oil-field conditions in miniature. Researches conducted in the Universiity of California laboratories, California Institute of Technology, University of Oklahoma, Colorado School of Mines, and by the United States Bureau of Mines, not only reveal that large reserves of oil not recoverable by ordinary methods exist in present oil fields, but that from two to four times the quantities removed by present methods may be forced from the earth by these new means.

The miniature oil field demonstrated that repressuring, or forcing of gas, air, or water into an oil reservoir, will yield more oil than flows by natural pressure and pumping. This device, which has yielded such sensational results, is the counterpart of an anticlinal structure. It consists of a steel tank shaped on the end like a crescent moon, with the points down, and measures five feet wide and eight feet long, while from its rounded top project a series of pipes. These are the oil wells, which may be caused to flow singly or in any combination.

Inside the tank, sand is tightly packed to duplicate the structure of a common type of oil stratum. When ready to operate his oil field, Uren dissolves natural gas in crude oil, exactly as it occurs underground, then forces the mixture into the tank under pressure. When the oil and gas mixture has filled all the spaces between the sand grains, the tank is in the same condition as an underground pool. The depth depends upon the pressure applied.

To duplicate the opening of an oil well, a valve on one of the projecting pipes is turned and at that moment, oil, forced outward by expansion of the gas with which it is mixed, begins to flow through the pipe much as it would escape from a new gusher.

Here, in a few cubic feet, important problems of draining large oil fields, of drawing from the earth the last possible barrel of oil, are being solved.

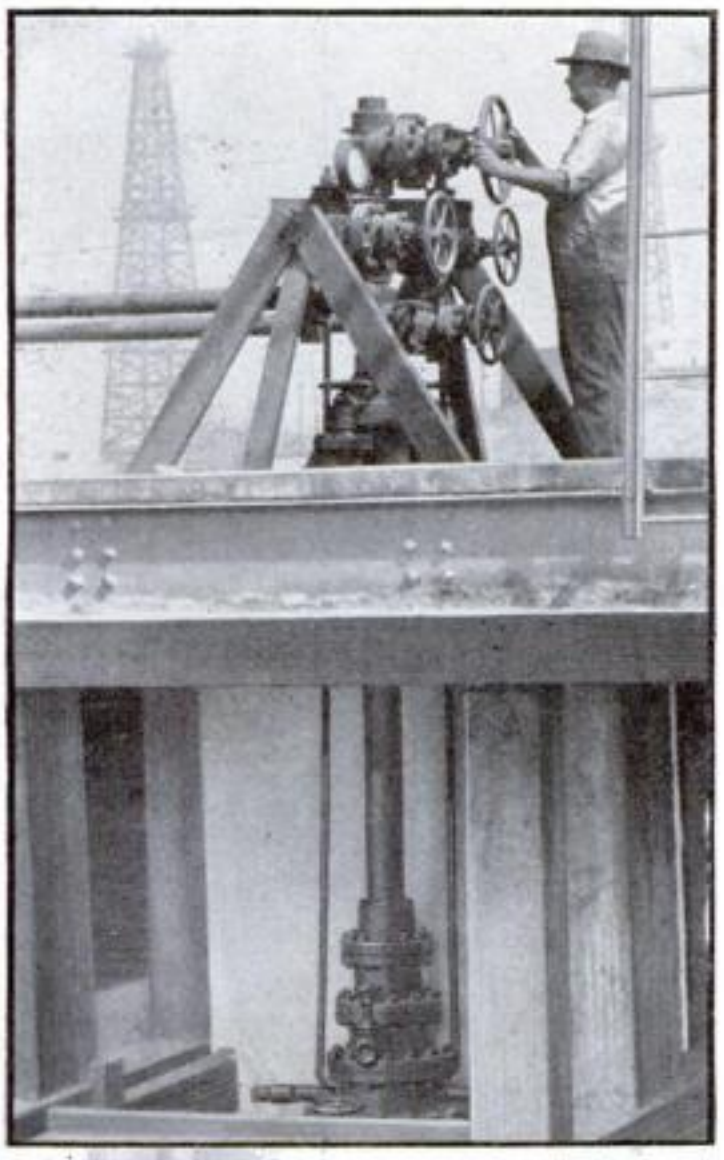
"Drainage," Uren explained, "offers more problems than any other phase of oil production. We learn from the miniature field that flush production, represented by wells flowing without pumping, and pumping, yield only about one fifth of the oil actually in the buried reservoirs.

"Means to recover the remainder are vitally necessary. First, however, it is important to know how oil behaves under varying pressures and in different kinds of sand. While gas pressure, pressure of water surrounding the reservoir, and gravity tend to force oil toward a well, capillary attraction of the pores of the reservoir rock, adhesion of oil to surface of the sand or rock, and the friction occurring as oil oozes through the minute pores tend to hold it back.

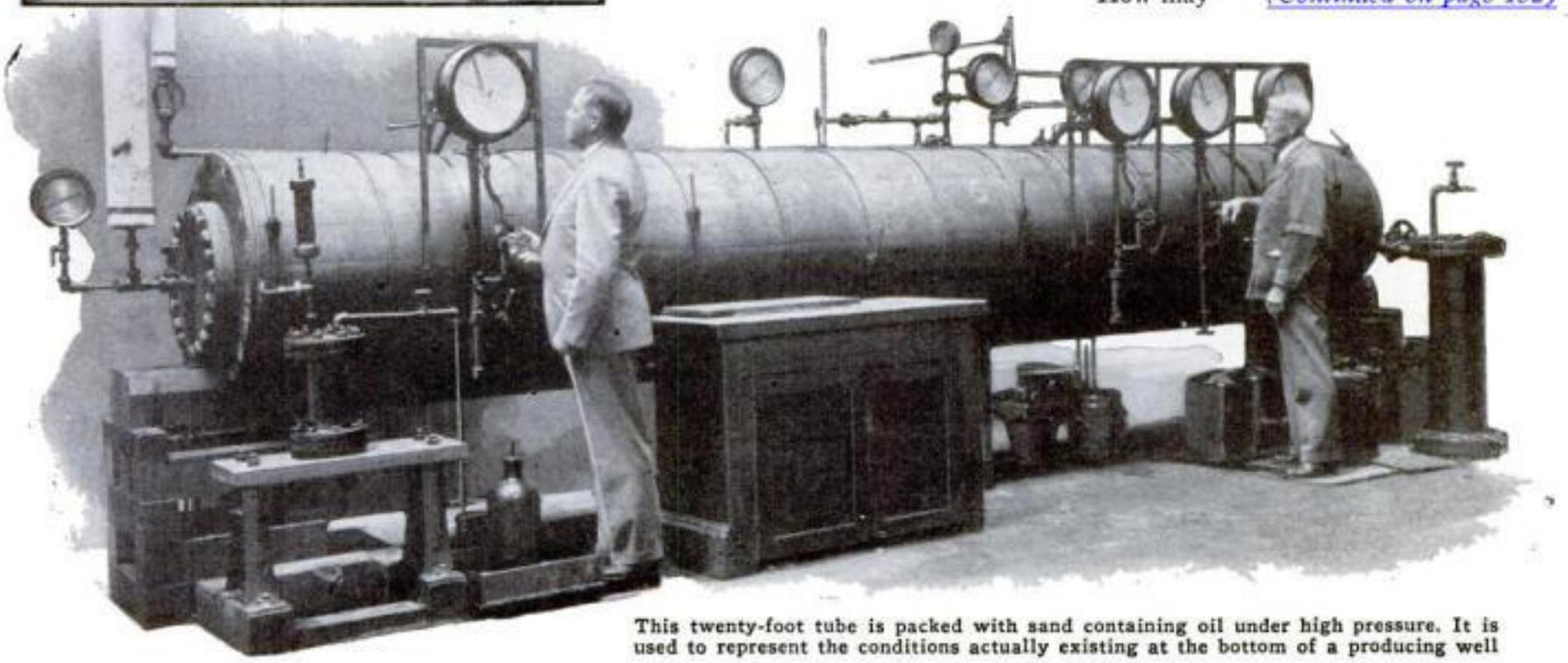
"Gas pressure may be tremendous. It is estimated that in the Kettleman Hills Oil Field, in California, where initial field pressures of upwards of 2,500 pounds per square inch exist, as much as 900 cubic feet of gas can be dissolved in one barrel of oil. This means that when a well taps such a reservoir, thereby releasing the pressure, the oil expands to about 120 times its original volume until it becomes only a thin film of grease surrounding countless gas bubbles. This explains why, when a well is brought in out of control, the wild oil stream blows the drill rig to pieces and showers the ground with oil for miles around.

"You would think such a force would drive oil from the earth with ease. But that's only part of the picture. You must remember that a cubic foot of sand may contain as much as 25,000 square feet of surface which must be wet with oil. To get this adhesive oil away from the sand is no easy matter."

How may *(Continued on page 132)*



Left, using a device, known as a "Christmas tree," to shut off a well and thus control its volume of flow



This twenty-foot tube is packed with sand containing oil under high pressure. It is used to represent the conditions actually existing at the bottom of a producing well

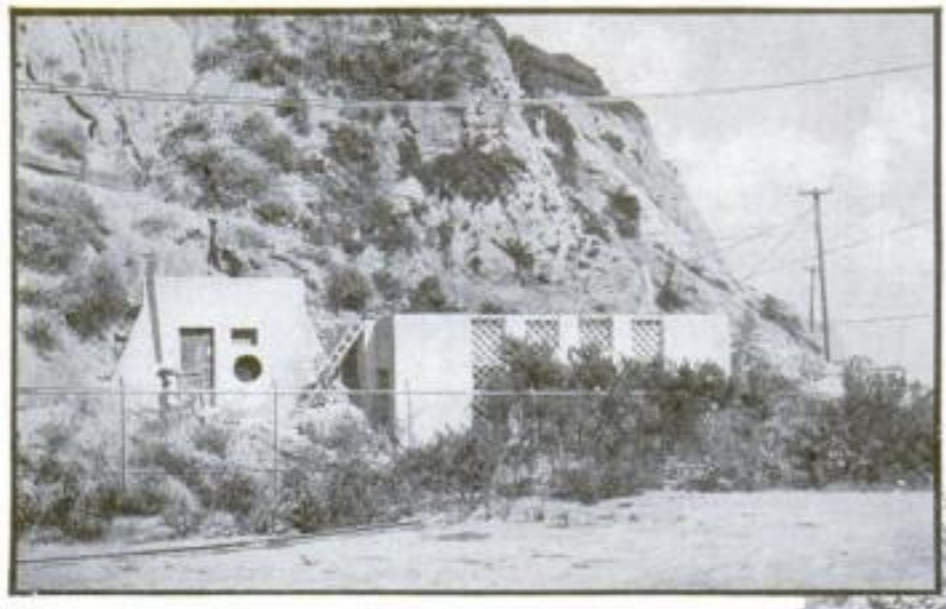
TINY RADIO AND SPEAKER FOR COPS ON BEAT

A NEW self-contained radio receiving set, designed to be carried by a policeman while walking his beat, employs a loud-speaker instead of the earphones usual with such portable outfits. The speaker is carried in the breast pocket of the shirt or tunic and is connected by wires with the receiving apparatus suspended from the belt, which also supports the batteries.

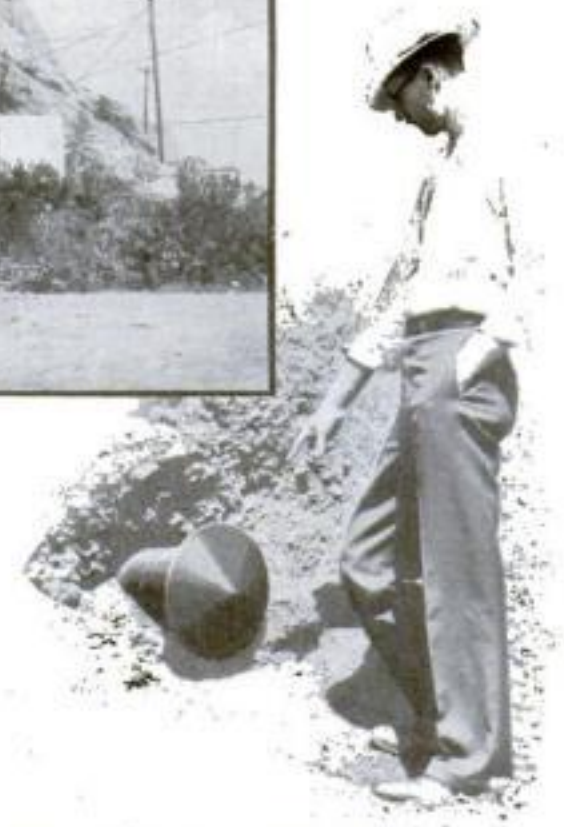
SELL AIR MILEAGE BOOKS

"Meal-ticket rates" for airline riders have been announced by two American transport companies. By buying a mileage book containing $500 worth of transportation, passengers can save fifteen per cent on regular rates, officials say.

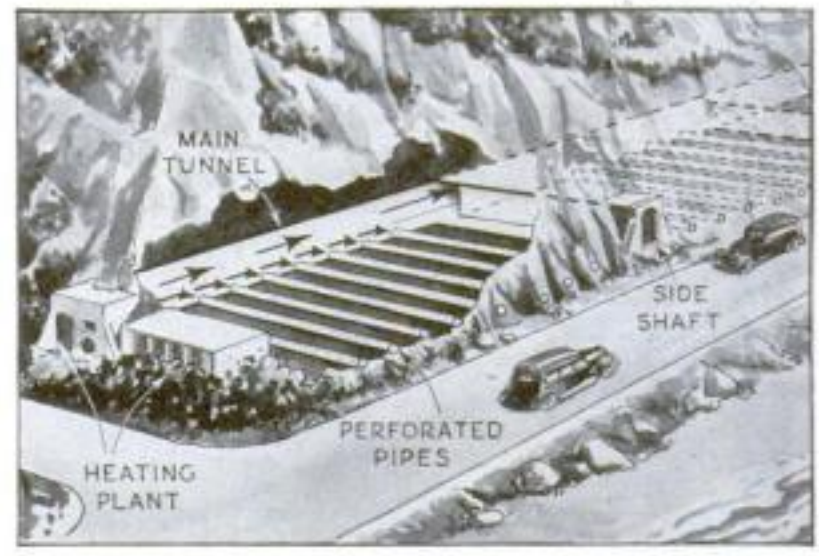
HEAT CLIFF TO CHECK LANDSLIDES



Heating plant set up to dry out a cliff. Below, the open end of one of the perforated hot-air pipes



INSTALLING a heating plant in the base of a 200-foot cliff, to stop landslides endangering homes and grounds at its top, was an unusual expedient recently tried with success in California. The slides were caused by water seeping out at the base of the cliff. To dry it out, a tunnel was dug parallel to the face of the cliff and 120 feet back from it. From this shaft, at intervals of about twenty feet, perforated ten-inch pipes were laid to the face. The ends, terminating in open air, were left open but were covered with protecting caps. An electrical warm-air furnace was set up at one end of the cliff, with motor-driven fans to drive the air along the tunnel and out through the perforated tubes. Auxiliary tunnels, dug to facilitate building the main shaft, facilitate drainage, and remaining moisture is effectively disposed of by the heating plant, which will be operated whenever the amount of moisture requires it.



Drawing shows how hot air is distributed to dry the cliff's face

NOVEL PIANO HAS SIX-ROW KEYBOARD

UNUSUAL musical effects are produced by a chromatic piano now being demonstrated in Germany. The half-tone keys, instead of being black and raised above the level of the others, are white and are placed side by side with the full-tone keys. The keys are disposed in six short ranks in place of the usual one long row, so that the player can span two octaves at once and may produce the same tone simultaneously on three different rows. The chromatic piano invented fifty years ago is only now being built commercially. The piano aroused interest by novel effects produced.

A musician demonstrating the chromatic piano. Half-tone keys are side by side with full-tone keys, in six comparatively short rows

BABY SWITCH FOR HIGH-POWER WORK

A NEWLY developed switch, no larger than a spool of thread, is capable of interrupting a current equal to five horsepower, a job that commonly requires a switch many times its size. Because of the vacuum in which the contacts operate, it eliminates the arcing flash which, with its attendant high temperatures, makes necessary the heavy construction of the ordinary high-power switch. Lead-in wires are insulated by glass beads encased in special metal alloys. The illustrations show the exterior of the switch and its internal construction.

PLANE CAN FLY WITH OR WITHOUT A TAIL

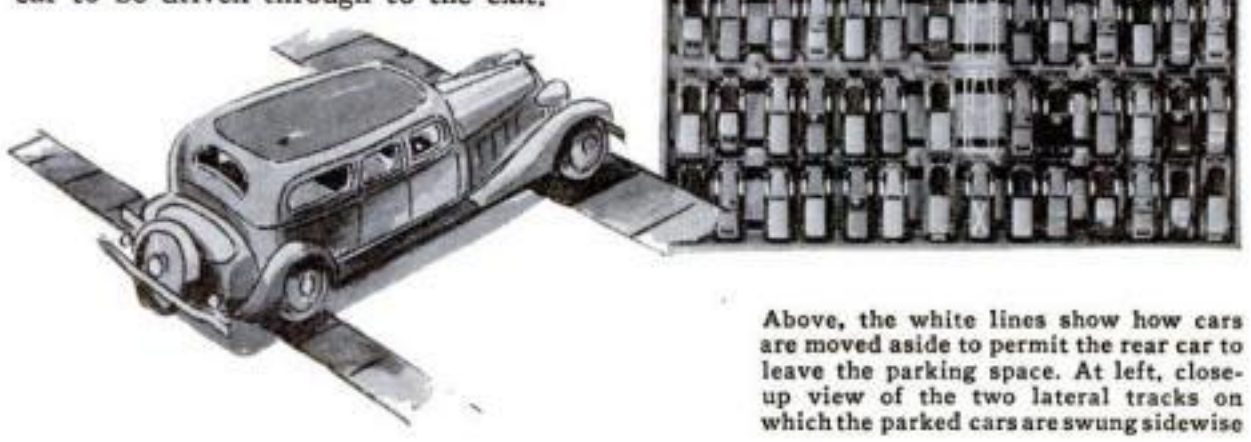
AN AIRPLANE constructed by a Coatesville, Pa., inventor is able to fly with or without a tail. Recalling the appearance of craft built in the pioneer days of aviation, the high-winged biplane is powered by a four-cylinder gasoline motor operating a single tractor propeller. The pilot sits amid open framework, as seen in the photo at left, in which the son of the inventor is shown piloting the machine with its tail removed for a test.

RADIO PICTURES REPRODUCED ON PAPER

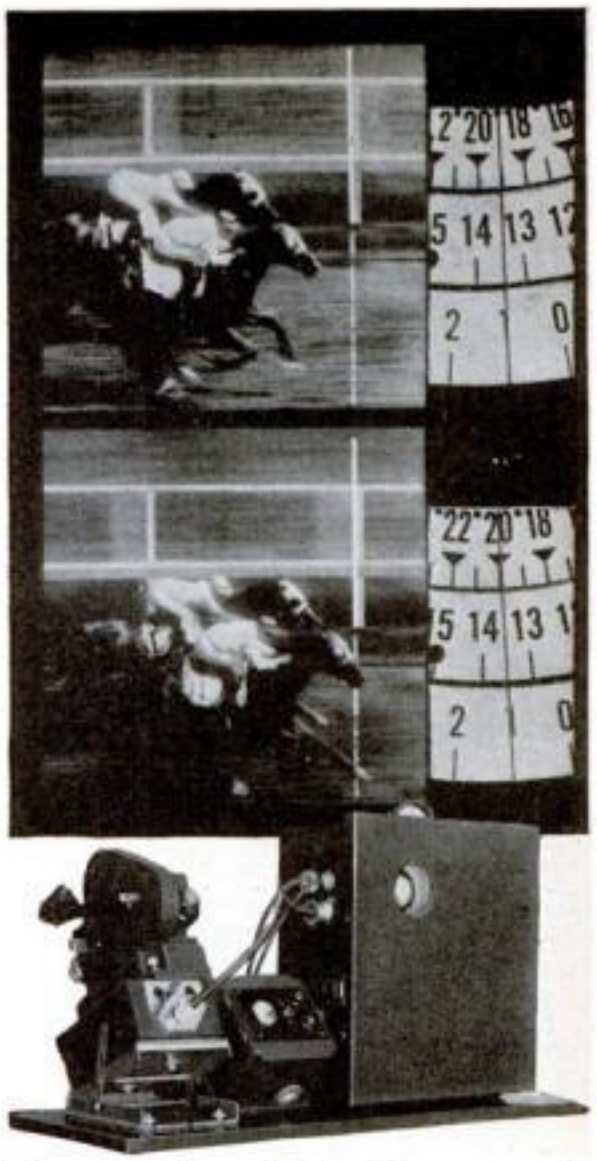
MESSAGES, maps, and pictures transmitted by radio are reproduced on paper, at the rate of a full letter-sized sheet every eight minutes, by an improved facsimile receiver perfected by RCA-Victor Company engineers. Synchronized with the transmitter, which operates on a standard scanning principle similar to that of television, it feeds carbon paper and white paper from rolls over a rotating drum bearing a spiral ridge. Fluctuations in incoming signals press the paper and carbon together against this ridge, making marks corresponding to the light and shade of the original. Early commercial use of the system is foreseen.

CAR-PARKING SYSTEM WASTES NO SPACE

WITH a new car-parking device approximately ninety-five per cent of the area of a garage floor or parking lot can be used for storing cars. In ordinary parking, about a third of the area must be kept clear to maneuver cars in and out of position. The new system employs two continuous motor-driven tracks for each rank of automobiles, one track for the rear and another for the front wheels of the cars. A file at one side of the floor is left vacant. When a car in one of the rear ranks is wanted, pressure on a button moves aside the cars on the front ranks, thus clearing a lane for the rear car to be driven through to the exit.



Above, the white lines show how cars are moved aside to permit the rear car to leave the parking space. At left, close-up view of the two lateral tracks on which the parked cars are swung sidewise



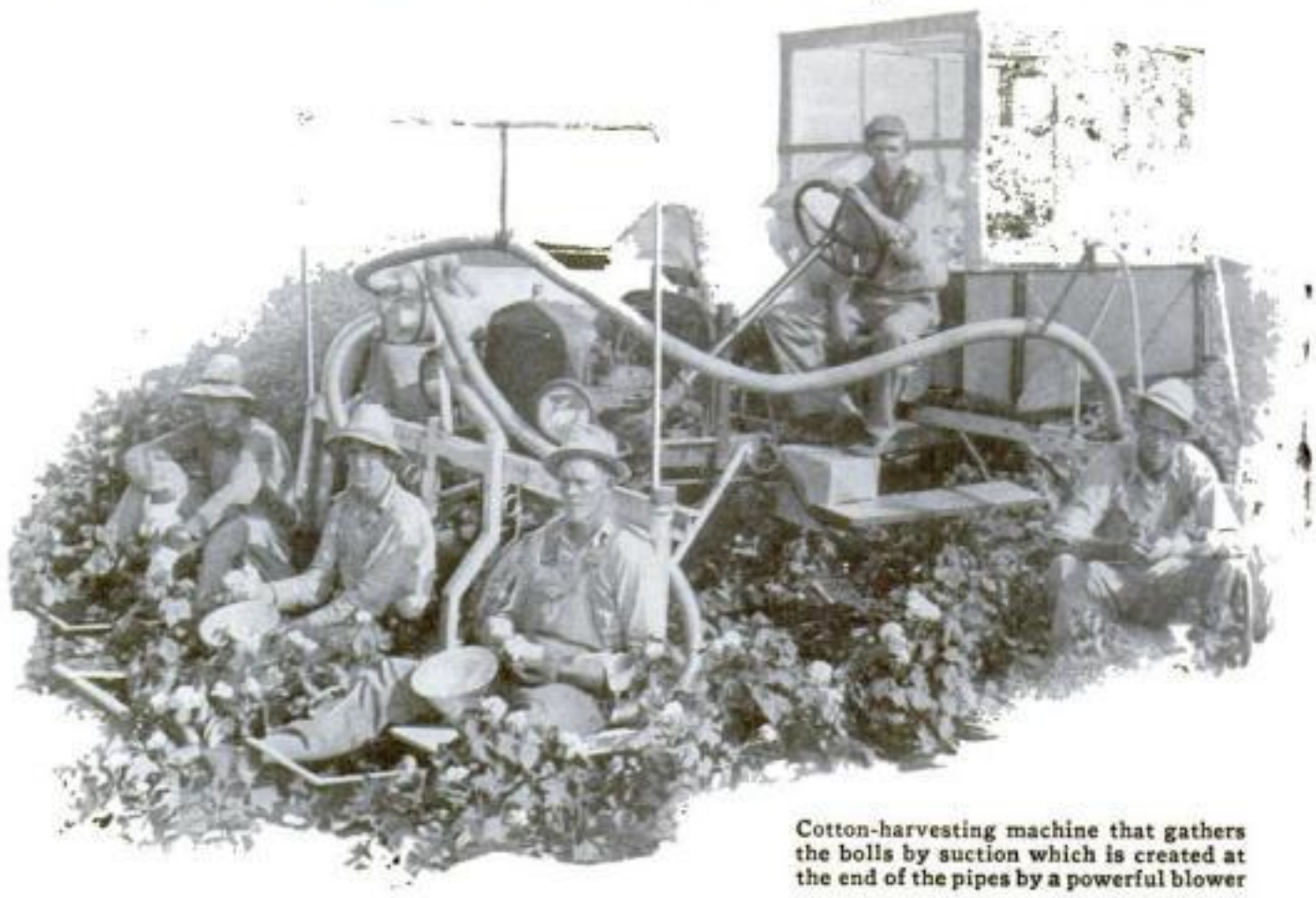
At top, test picture of finish of horse race made with the high-speed timing camera shown above

HIGH-SPEED CAMERA TO DECIDE HORSE RACES

PHOTOGRAPHIC evidence, rather than the opinion of judges, will pick the winners of horse races in a system to be tried out for the first time this month at the Santa Anita track near Los Angeles, Calif. The system uses a high-speed timing camera developed by Western Electric engineers, and permits results to be announced, and photographs of the finish to be posted for public inspection, within three minutes after each race. Cameras at the finish are started just before the leading horse crosses the line, and the section of film recording the end of the race is then rushed through a high-speed developing cabinet of new design where developing and fixing are completed in thirty seconds each. An operator views the developed film as it passes between two glass plates in a wet enlarger. As the frame recording the finish of each horse comes into view, he presses a button, automatically stopping the film and making a bromide enlargement to be rushed to the judges. Under present procedure, winners of the race are posted immediately, but bets are paid off only after the horses have returned and the jockeys weighed in. With the new system, prints will be in the judges' hands, for their final decisions, by the time the jockeys have weighed in, and duplicate prints will be on view at the betting booths immediately afterward. The prints show not only the order of finish but also the time of each horse. The system also comprises auxiliary timing apparatus and ordinary motion picture cameras spaced at intervals along the track, to time the entire progress of the race and supervise the conduct of the jockeys at all points on the race course.

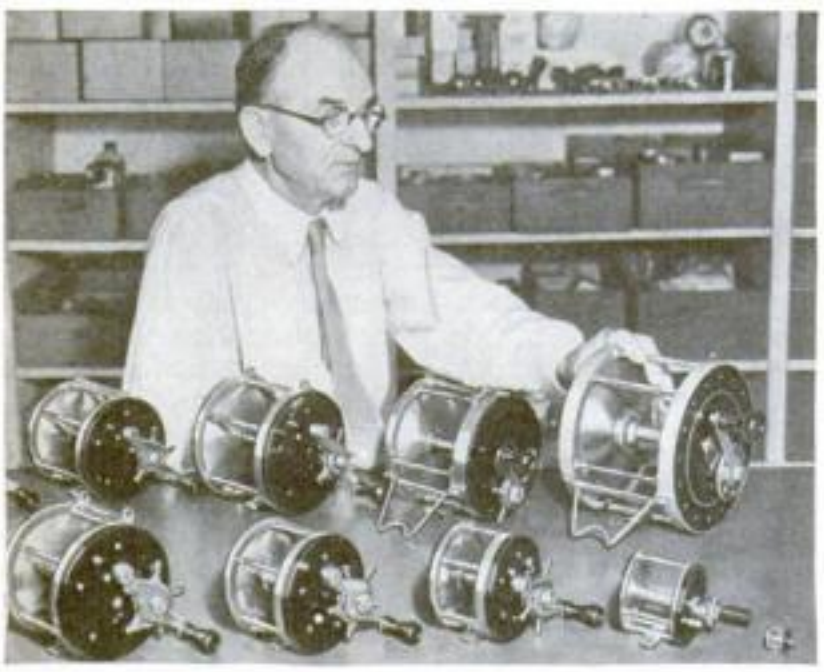
New Machine Harvests Cotton by Suction

DESIGNED to speed up cotton harvesting, a machine invented by a Gainesville, Texas, insurance man operates by suction. This is provided by a huge blower mounted on a tractor and actuated by its engine, in such a way that the blower has two speeds independent of the tractor's movement. Five men besides the driver ride the machine on seats suspended above the cotton rows, picking the cotton and dropping it into funnels attached to metal hoses that carry it to the blower. The funnels may also be detached and the hose guided by hand, the suction plucking the cotton from the bolls. In the blower, the cotton is removed from the burrs and hurled into a screen container. Tests in Texas fields showed that twice as much cotton was gathered in one day by the harvester's crew as by an equal number of men picking by hand. The process is reported not to interfere with unmatured bolls.



Cotton-harvesting machine that gathers the bolls by suction which is created at the end of the pipes by a powerful blower

ANGLER DESIGNS REELS OF ALL SIZES



BUILDING a fishing reel so tiny that a five-cent piece would cover its side plates, or so large that it holds four miles of linen line, are equally easy tasks for J. A. Coxe, expert deep-sea angler and former president of the Catalina Tuna Club in California. These are the smallest and biggest of the many reels he has designed and constructed for fellow anglers. The occupation was virtually thrust upon him when friends, admiring an "unbreakable" model he made for himself, demanded similar equipment.

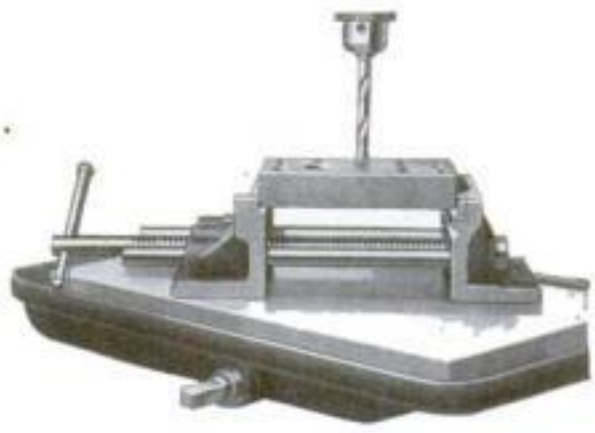
NEW GOLF-BALL TEE REVOLVES WHEN HIT

SOMETHING new for golfers is a spinning tee, devised by a Chicago inventor. Whirling freely when struck, it is claimed to offer no resistance to impede or deflect the drive. Since there is little chance for the club to strike the tee itself, it is seldom lost.

ELECTRIC MACHINE SPINS SPIDER WEBS

WHEN one large motion-picture studio needs cobwebs for a scene, it manufactures them with a home-made machine that spins webs as fine and natural looking as the real thing. The device consists of an electric hand drill, the blades of an electric fan, and a conical metal container. This metal cone, which has a perforated base, holds a quantity of liquid rubber and, like the fan blades, is attached rigidly to the shaft of the drill. When the fan blades are revolved at high speed, they cause a strong current of air which in turn creates a vacuum at the base of the cone, drawing fine filaments of the liquid rubber through the perforations. By careful movements of the machine, cobwebs can be produced in almost any pattern that may be required.

This electric fan draws out liquid rubber to form cobwebs



NEW DRILL-PRESS VISE QUICKLY TRUES UP JOB

WORK, resting on built-in parallels in an improved drill-press vise just introduced, is speedily and accurately trued up for drilling. The new design dispenses with the use of separate parallels, and the clearance it provides minimizes interference from chips and burrs. The vise may be used standing on its base or on either side, and has a V-notch for holding round shafts.

You Never Can Tell

By BERTON BRALEY

If your scion loves to putter
With the innards of a lock
And he builds things out of gadgets that you own,
If his room is all a-clutter
With the pieces of a clock
And he *will* not leave your set of tools alone;
Watch your temper! Do not utter
Words you'd better hold in check.
Give the kid's imagination room to roam;
Make him tidy up the clutter
But don't jump upon his neck
For you *may* have an Inventor in your home!

Edison was not a model
Of a "regimented" kid
Who was never any bother to his dad;
Ford had fancies in his noodle
And a lot of things he did
May have made his troubled parents pretty mad.
When *you* find some new appliance
Which your son has ripped apart,
Don't assume there's *only* mischief in his dome,
For it may be love of Science
That is budding in his heart
And you *may* have an Inventor in your home!

If your eager boyish tinker
Sort of messes things a lot
Make him put them back in order when he's through,
But—*don't* daunt a future thinker,
Like a Tesla or a Watt,
Who may show the way to wonders that are new!

PUTS RADIO IN BABY CARRIAGE

A CHICAGO father has made his strolls with the baby carriage more enjoyable by building a radio into the vehicle. He mounted the receiver itself upon the foot rest, and for power tucked batteries of air-cell type into the bottom compartment. The loudspeaker is directed straight downward, and provides a serenade at will to entertain baby or parent.

A new arc lamp, burning twin pairs of carbons, furnishes strongest light

RECORD LIGHT FROM NEWEST ARC LAMP

A DAZZLING new carbon arc light, recently developed in connection with chemical research, is said to shed a brilliance twice as great as any artificial light hitherto produced. In principle it differs little from the sputtering old street lamps in use thirty years ago, but in size and blinding radiance the new lamp represents a tremendous advance over the somewhat similar primitive lights. In experiments conducted with the lamp, scientists have shown that carbon, unlike the majority of common substances, does not melt or boil before passing into a gaseous state. They have discovered that it is transformed directly from a solid into a gas at a temperature of nearly 6,400 degrees Fahrenheit as produced by the arc.

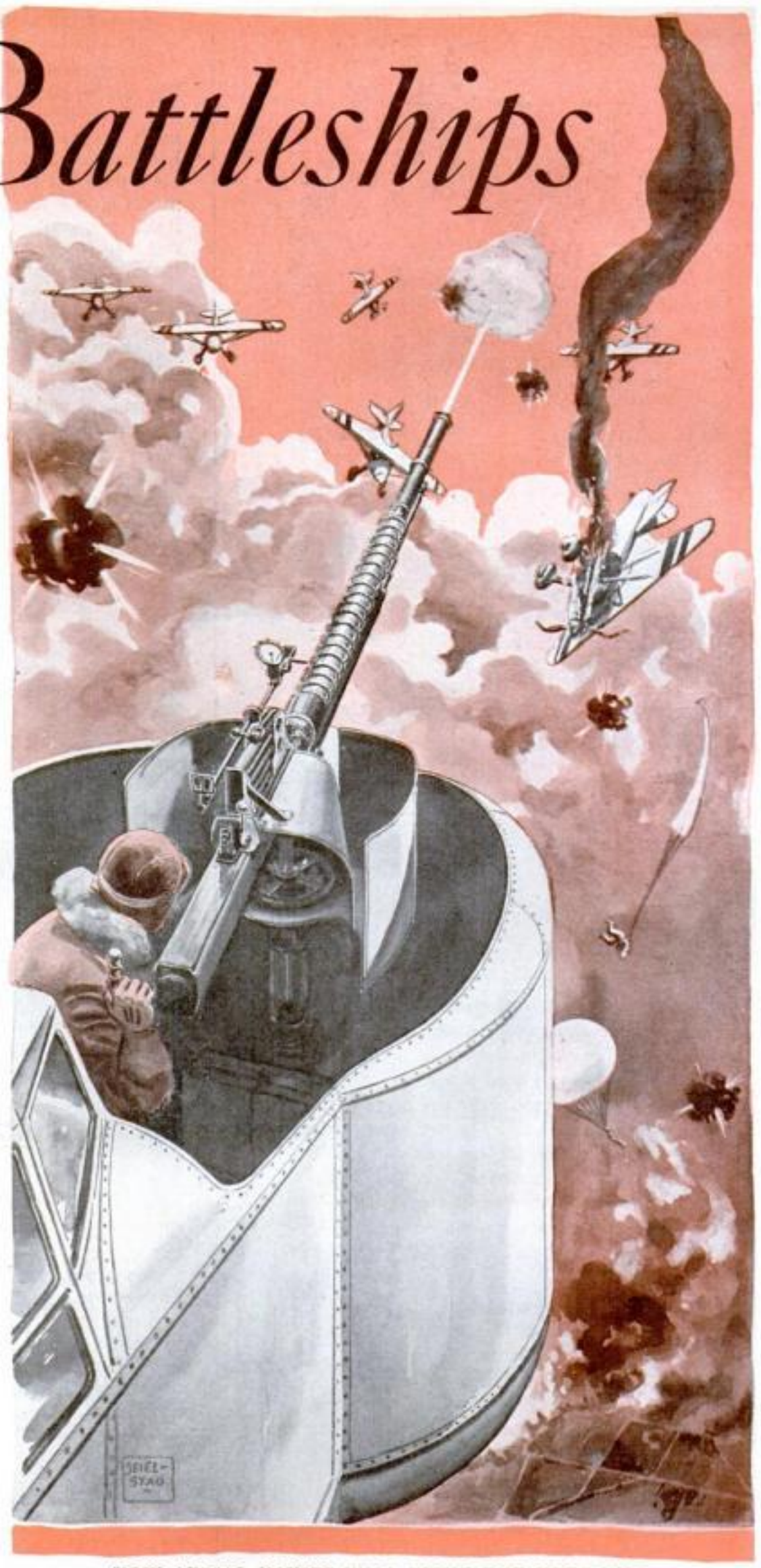
NEON LIGHTS TRANSFORM TRUCK

BEDECKED with 600 feet of neon tubing, a gasoline truck placed in service by a western oil company glows like a Christmas tree as it travels along the road. Those who see the startling apparition of red, blue, and yellow light find the explanation in illuminated lettering advertising the firm's product. A decorative effect is secured by outlining the whole truck body, including radiator, fenders, tops, sides, and rear, in colored tubing. Four high-frequency generators, operated from the fan drive of the motor, supply electricity for the lighting system, which is said to be unique.

This gasoline truck is outlined with neon lights of various colors that glow in 600 feet of tubing. The radiator has golden light and the fenders have blue

Flying Battleships

By Alden P. Armagnac



HOW AERIAL NAVIES WILL FIGHT THE NEXT WAR

Air battles of the future will be fought in this manner, according to our artist, who visualizes the effect of high explosive shells. The cannon here illustrated has already been installed in British airplanes and may be adopted by other nations

BATTLESHIPS of the air, spouting death from bristling cannon, will sail majestically across the skies, exchanging screaming shells and blasting one another to atoms high above the earth.

No fantastic nightmare is this arresting picture. It represents the sober opinion of many an informed military observer as to the role of the airplane in the next war. That planes will bombard each other at long range with high-explosive shells, as warships of the sea now do, is a startling, but logical, consequence of the development of aviation's latest and most terrible weapon, the flying cannon.

Only the other day a big French war plane successfully fired a three-inch gun 3,000 feet above the earth. It gave an idea of the type of artillery that, all unknown to the average civilian, is being developed in guarded workshops for future air battles. Several powers are known to have ready at this moment, should war occur, aerial cannon that make the machine guns of the last war seem puny by comparison.

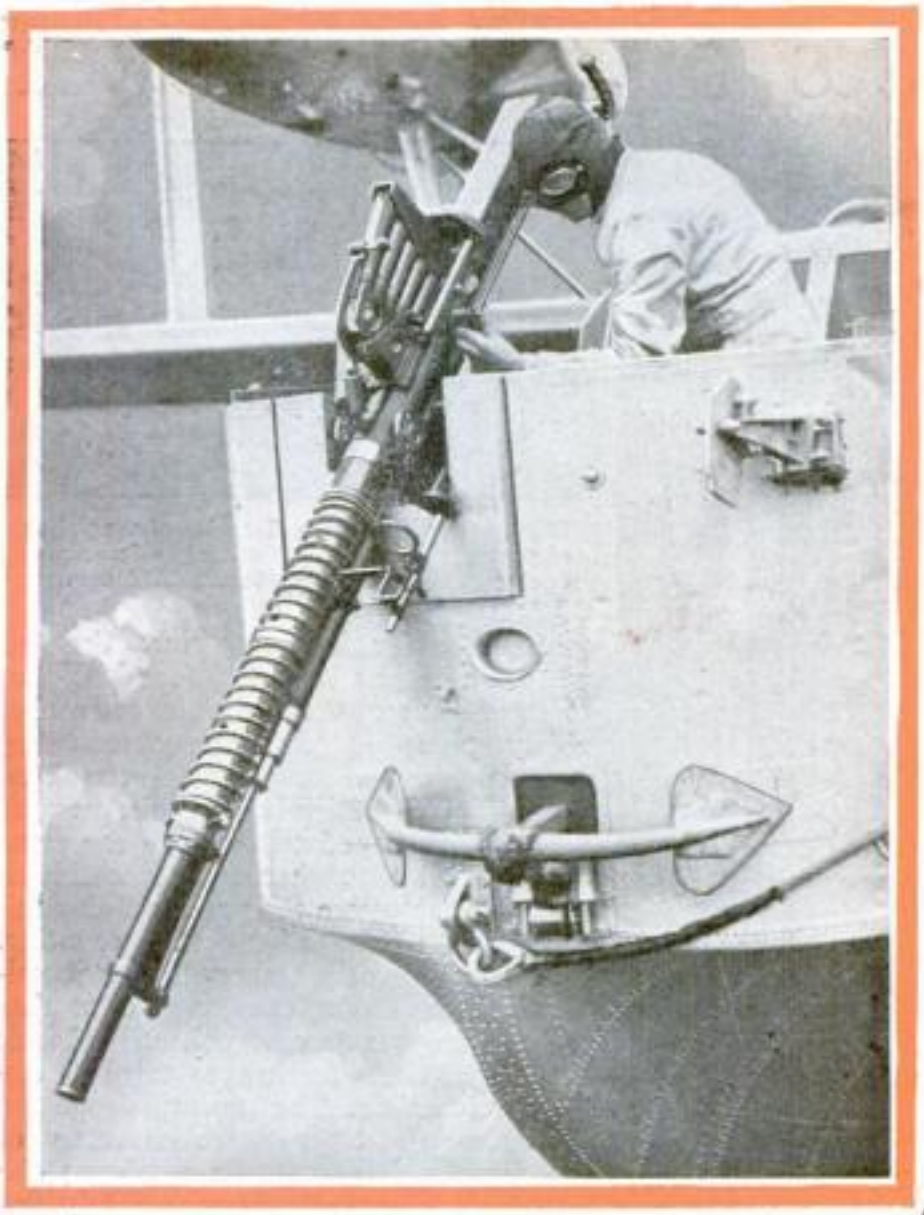
Besides the three-inch gun just mentioned, France has a twenty-millimeter cannon for planes that can hurl 400 shells a minute into the air, thus firing explosive projectiles almost at machine-gun speed. British designers have countered with a thirty-seven-millimeter cannon that fires 100 rounds a minute. Information as to whether any type of airplane cannon is under development by our own air forces is closely guarded by U. S. military officials, but few powers are believed to be neglecting its consideration; for its terrific striking power seems destined to effect a virtual revolution in air tactics.

Two factors give the new weapon its tactical power. First, a flying cannon far outranges a machine gun, so that a pilot armed only with a machine gun could be bombarded long before he could fire a single effective shot in return. Second, a plane may be riddled with machine gun bullets and suffer no serious damage, if no vital part is struck; but one direct hit with a high-explosive shell anywhere on the machine is almost certain to put it out of business.

Spurred by these incentives, the race among the powers to develop a successful airplane cannon began as early as the world war. During its first year, France bombarded enemy ground positions effectively with thirty-seven-millimeter cannon mounted in Voisin two-seater planes. Guynemer and Nungesser, famous French aces, later tried out air cannon of equal caliber in actual air battles. Since these were single-shooters, mounted in single-seater planes, the pilot had not only to guide his machine but to load, aim, fire, and reload his gun for every shot. Therefore Guynemer also carried a pair of machine guns, and when asked whether these or the cannon had downed a foe, he replied that he did not know, for he had simply given his adversary "the works."

Toward the close of the war, the United States was experimenting with one of the strangest of aircraft cannon, a gun that fired two ways at once. Intended for use against submarines, it hurled a powerful shell forward, while a harmless charge of bird shot and vaseline was expelled from the open rear end to take up the force of recoil. The gun was fitted with stops so that the rear charge could not hit the plane, which did not interfere with pointing the weapon downward at the water.

How Nations of the World Are Engaged in a Feverish Effort to Develop Destructive Air Artillery Is Described in This Article



Mounted in a huge seaplane, this English-developed flying cannon fires a thirty-seven-millimeter explosive shell that is capable of putting a plane out of commission with one shot

A machine gun was attached to its barrel and was intended to be fired first, the big gun being discharged when the bullets splashed near the target. None of these guns had passed the experimental stage, however, at the time of the armistice.

After the war came the transformation that made the aerial cannon no longer an experimental weapon but one of deadly effectiveness—the change from single-round to automatic firing. From later refinements have developed two distinct types of air cannon best illustrated by models currently installed in war planes.

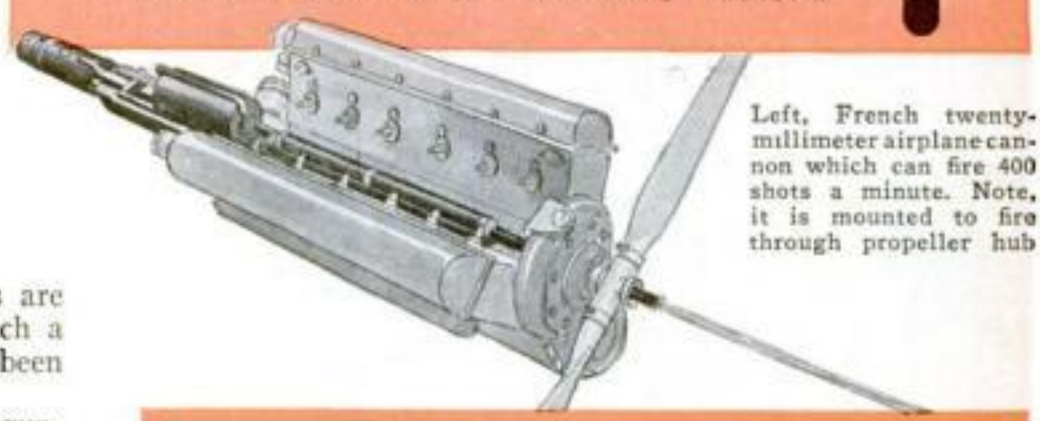
French designers favor a fixed cannon that the pilot aims by pointing the entire plane at its target. Their pride is a twenty-millimeter rapid-fire cannon permanently fixed between the banks of cylinders of a V-type airplane motor and designed integrally with it. Its amazing 400-round-a-minute rate of firing is attained by loading its projectiles through a compressed-air system, operated by an auxiliary compressor attached to the motor. Through a unique expedient, there is no need to synchronize the gun with the propeller blades past which it fires, since the projectiles are shot through the hollow hub of the geared propeller. Such a gun can be handled effectively by a lone pilot, and has been installed in French single-seater fighting planes.

British design prefers a movable cannon, handled by a gunner who is not required to concern himself with piloting. Its latest achievement is a thirty-seven-millimeter gun that can be swung in any direction, using its own recoil to load and fire either of two types of projectiles at the rate of 100 a minute. One is an explosive shell for use against hostile aircraft, which has a sensitive contact fuse that explodes it on striking aircraft fabric. Should it miss, a "tracer" fuse destroys the shell before it falls to earth, lest it descend in friendly territory. The other type is a delay-action, armor-piercing shell for use against tanks and submarines. Several huge flying boats of 100-foot wingspread have been equipped with this gun, which has sufficient recoil to check by ten miles an hour the speed of this mighty craft.

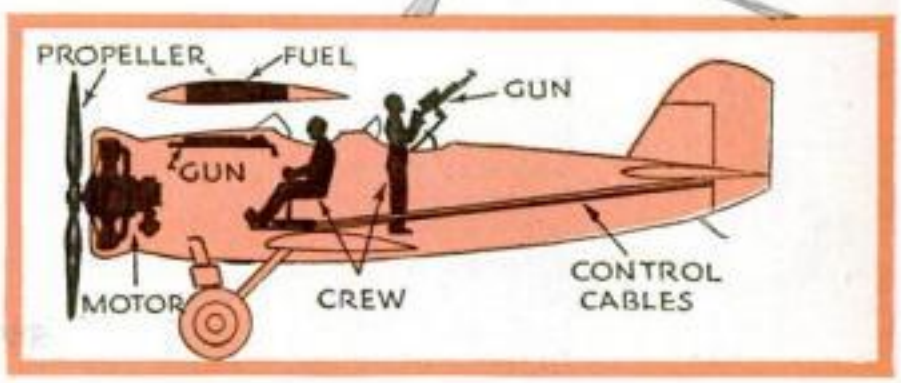
The recoil of such powerful guns might seem likely to tear so fragile a structure as an airplane to pieces. What most persons do not realize, however, is that an airplane in flight is, by its very nature an ideal recoil-absorbing platform. The fact that it is surrounded by nothing more resistant than air, and the elasticity of its own structure, minimize the shock of discharging a big gun; and the larger the plane, the larger the gun that can be carried and fired. It is said that the two giant DO-X planes, largest of their type in the world, recently purchased by Italy, are provided with gun emplacements. What type of cannon might be carried in craft of such size, and what havoc they might work in warfare, can only be left to the imagination.

Thus the airplane becomes a more potent factor in battle strategy than ever before. As well as shelling each other with such weapons, aircraft will be able to constitute themselves as ultra-mobile artillery to attack columns of troops, railway trains, strategic enemy lines of communication, and hostile searchlight batteries. While ground artillery is not susceptible to rapid transport from place to place, to meet the shifting tides of battle, airplanes equipped with flying cannon could be dispatched at a moment's notice during the height of a conflict, and could speed at a hundred miles an hour to critical points, arriving in time to play a decisive part in the struggle. Had squadrons of such craft been available to either side during the world war, it seems reasonable to suppose that the history of many of its major battles would need to be completely rewritten.

Left, the machine-gun cartridge of the World War, the thirty-seven-millimeter projectile of the flying cannon, and the seventy-five-millimeter shell. Below, drawing shows how plane armed with cannon would outrange an ordinary machine gun



Left, French twenty-millimeter airplane cannon which can fire 400 shots a minute. Note, it is mounted to fire through propeller hub



To disable a plane with a machine-gun bullet, it must be hit in one of the vital parts, colored black in this illustration. With an aerial cannon, the plane would be disabled if a shell hit any part of it

Search Sky for Facts on Hay Fever

One of the planes used in the hay-fever survey, and pollen-collecting outfit for installation

What pollen looks like. Samples of the pollen of timothy, ragweed, and other hay-fever-producing plants, as magnified 3,500 diameters

FIVE planes roared into the air from Somerton airport near Philadelphia, Pa., the other day, to inaugurate a five-year search for the causes of hay fever. The investigation is sponsored by the Philadelphia College of Pharmacy and Science. In daily flights during the hay-fever season, the planes will collect the microscopic, air-borne grains of pollen responsible for its symptoms. Samples will be taken at each 250-foot level, up to an altitude of 2,500 feet, over an area eighty miles in diameter surrounding Philadelphia and another on the New Jersey coast. Pollen-bearing air, trapped by a funnel-shaped collector on the plane wing, is led through a tube into liquid-filled bottles where it is retained for microscopic identification and counting. Gages in the cockpit show the total volume of air yielding each sample, so that the relative quantity of pollen in the air at various times and places can be compared accurately. The survey is expected to explain the comparative immunity of hay-fever sufferers at the seashore; the paradoxical immunity season of July and early August; and the frequent aggravation of symptoms after sundown. The effect of rain, electrical storms, humidity, and wind will also be determined.

Close-up of the meter that gages amounts of air from which samples of pollen are collected

ZOO GETS FLYING SNAKE

This rare snake can soar through the air

A SNAKE that soars through the air has just been acquired by the Barrett Zoo, Staten Island, N. Y. The flying snake, a native of the Malay Peninsula, achieves flight by flattening itself to resemble an inverted trough. With its body thus curved, the snake becomes a living glider and is able, with the power of its spring, to hurl itself over surprising distances. It is one of the few of its kind ever brought to this country and is considered a valuable addition to the zoo's collection.

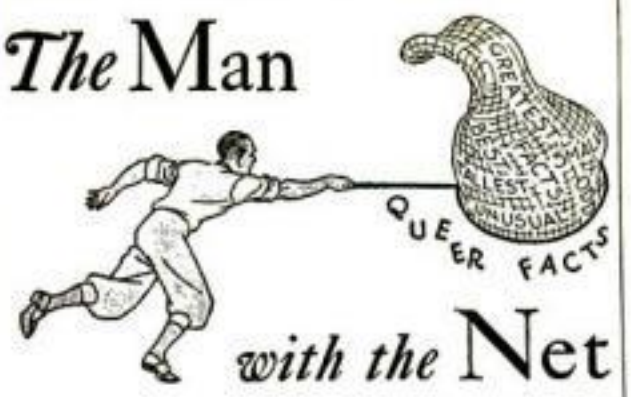
WASHABLE BINDING FOR SCHOOLBOOKS

Left, inserts show sample of ordinary binding, and of the new material after exposure to insects. The new binding is unharmed

Below, test demonstrates the waterproof qualities of the new binding. It can be washed with soap and water without damage

INTENDED to help prevent the spread of infections among school children, a recently developed textbook binding can be cleaned with soap and water or washed with disinfectants without damaging either the binding or its color. The basis of the new binding is a cotton fabric. This is impregnated under pressure with a waterproofing compound of pyroxylin, a substance derived from cotton and used as a basis for lacquers. The binding, in addition to resisting water and stains, also protects books from the attacks of destructive insects. Being stronger than the usual binding cloth, it is said to increase the life of much-used books.

The Man with the Net



A DRIVEWAY *with tellers is provided by a bank in the west so motorists can make deposits without getting out of their cars.*

ALL THE SALT *in the oceans would cover the United States with a layer a mile and a half deep.*

WHEN ASKED *to pick any number between one and ten, most people pick seven.*

ONE-FIFTH *of all the people accidentally killed in America die in accidents caused by poor vision.*

A MAN *can read a newspaper by the light produced by a Costa Rican Lantern Fly.*

MORE *substances will dissolve in water than in any other liquid.*

OUR EYES *see only one star in 5,000,000.*

RUSSIA *has the most children; France the most old people. Almost fifty percent of the people in Russia are under twenty years of age. Thirty-one percent are under twenty in France, thirty-nine percent in the United States.*

PURE SILVER *is used to kill bacteria in a German swimming pool. The disinfectant is formed by mixing one part silver in a quarter billion parts water.*

THE AVERAGE *thundercloud holds about 1/200th of a cent's worth of electricity.*

THE FIRST *gold ever obtained from the sky was mined from a stony meteorite recently found near Melrose, New Mexico.*

SACCHARIN, *300 times as sweet as sugar, comes from coal tar.*

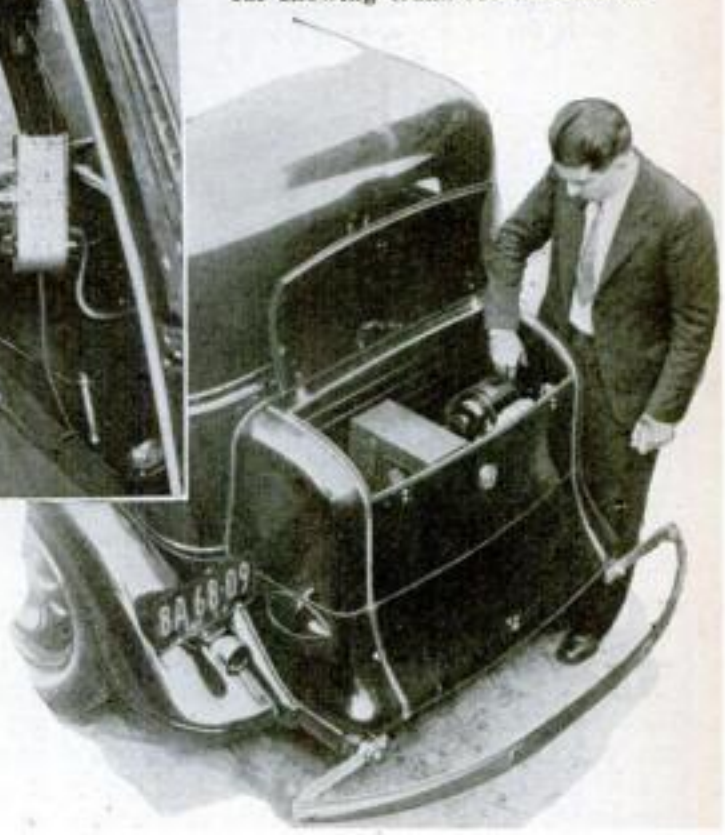
FARMERS *in Southern California are adding plant food to irrigation water. Ammonia gas in the water has proved as nourishing as nitrogen fertilizer.*

CHICAGO *is nearer the center of the earth than New Orleans.*

COLUMBUS *had freckles. According to a recently discovered book, written twenty years after his death, he was also "big," "sharp-eyed" and had a "long red face."*

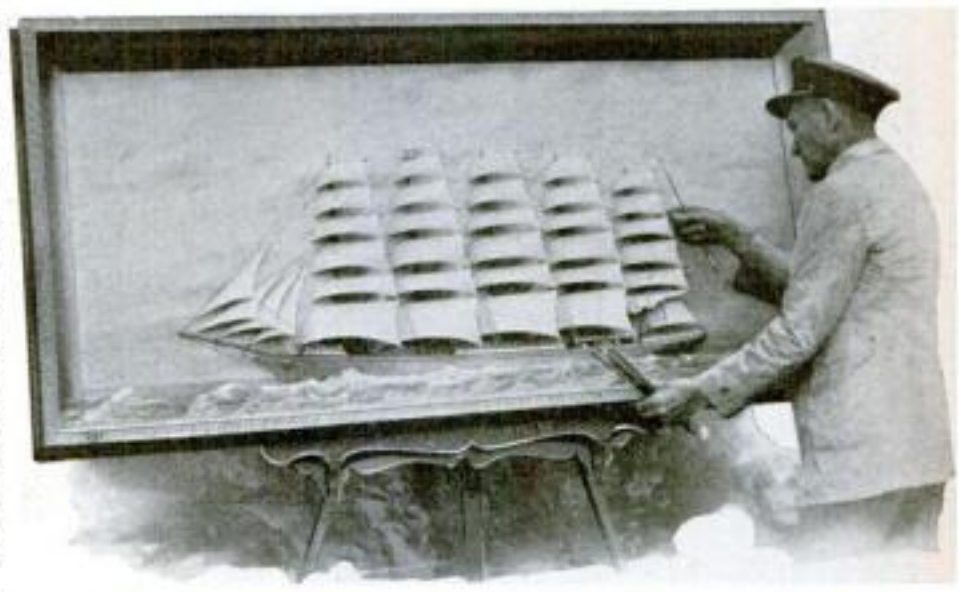
TWO-WAY RADIO SET FOR POLICE CARS

Left, carrying on two-way conversation from police car with new radio outfit. Below, rear of car showing trunk for transmitter



A ROVING police car, equipped with a new two-way short-wave radio set can transmit messages as well as receive them. Moreover, a vehicle carrying this outfit is not easily spotted as a police car since the set's transmitter requires no recognizable aerial. The role of antenna is played by the rear bumper, which to all appearances is part of the car's standard equipment. At one end, the bumper is insulated from the car by fiber washers and at the other end it is grounded to the car frame. The transmitter is concealed in the rear trunk and rests on rubber cushions to eliminate shock. The receiver is mounted under the dash. Instead of a speaker and microphone, the new radio uses a standard hand telephone set. This is carried on a hook mounted on the dashboard.

CARVES MODEL SHIP ON WOODEN WATER



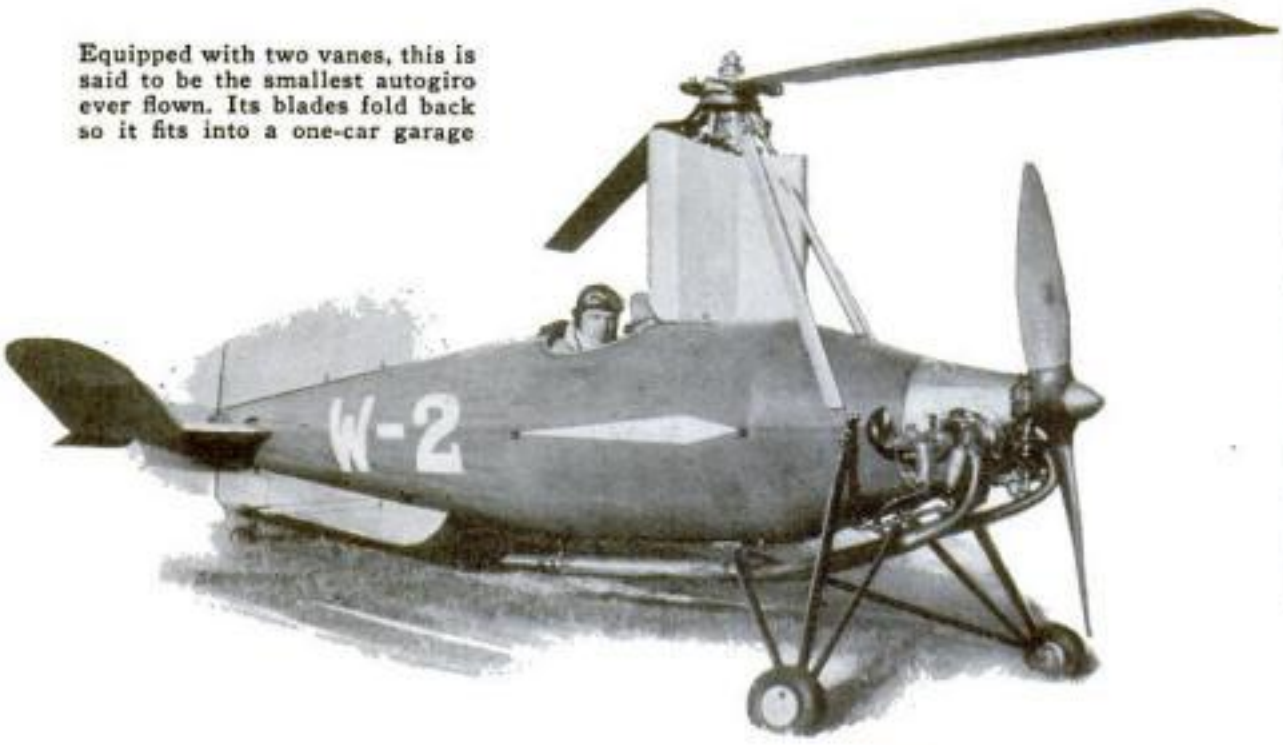
Remarkable ship model under full sail on an ocean carved from wood

CURIOUS ship models, carved by Andrew Axel, a retired Los Angeles sea captain, have wooden sails and plow through wooden oceans. The captain, a skilled marine artist, paints his own sky and cloud backgrounds for the model ships and colors both ship and the wooden water in natural tones. Only half a ship is actually modeled. This is glued down upon the oil-painted background, and the water, carved in fine detail upon a six-inch piece of wood, is fixed to the bottom of a deep frame. The frame is then set over the completed model. The effect is one of complete realism. The captain has produced hundreds of models of this kind, including one of President Roosevelt's yacht, *Amberjack II*.

WEDGE ON HAMMER PULLS NAILS

RECENTLY devised by a Des Moines, Iowa, inventor, a new hammer requires no block of wood thrust beneath its head in drawing long nails. A triangular extension of the head serves this purpose, increasing the leverage of the handle and also, it is claimed, pulling a nail out straighter than is possible with a conventional tool. The top of the triangle is knurled to prevent slipping. The inventor also has developed a wedge-shaped attachment which converts an ordinary model into one of the new type.

TINY AUTOGIRO FITS ONE-CAR GARAGE



Equipped with two vanes, this is said to be the smallest autogiro ever flown. Its blades fold back so it fits into a one-car garage

SMALL enough to be tucked into a single-car garage, a midget autogiro, that recently completed its test flight in England, is said to be the smallest ever built. Unlike larger craft of its type, the midget's rotor has only two blades, which can be folded back to save hangar space. The power plant is a small two-cylinder engine. Since it is easy to handle, the midget autogiro is expected to prove popular as a private airplane. Should demand make it possible to produce the ship in quantities, it is estimated that the cost would not exceed that of a medium-priced automobile. Like other autogiros, it does not require a large space for landing.

TWO PAIRS OF GOGGLES ARE COMBINED IN ONE

TWO PAIRS of goggles are combined in a new convertible model. Tinted lenses, for welding, may be pushed out of the way when not needed, permitting the heavy inner lenses of clear glass to be used alone for chipping or other hazardous operations. The ease of making this adjustment removes temptation to risk going without goggles, rather than change them.

VALVE FOR HOSE OPENS AND CLOSES ITSELF

AN INGENIOUS new valve, built into a flexible nozzle for water or air hoses, starts the flow when the nozzle is flexed and stops it when the nozzle is allowed to straighten, automatically preventing waste. When used with a radiator filling hose, as above, it also ends splashing and dripping, and permits a boiling-hot radiator to be filled from a safe distance, eliminating the risk of scalding the hands and face.

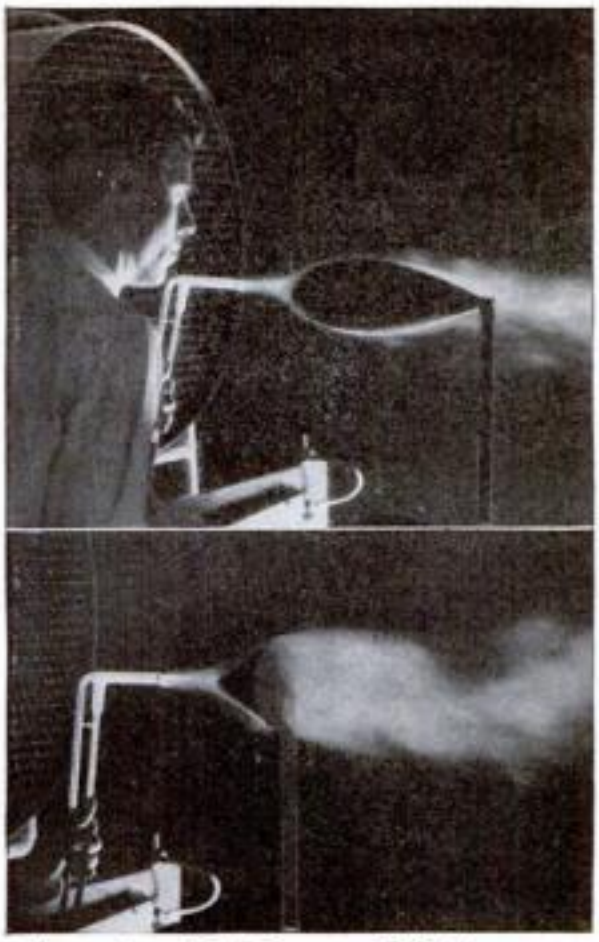
MINERS STAGE ROCK-DRILLING RACES

WITH intererest increasing in metal mining, the sport of hand rock drilling contests has recently been revived in the West. Gathering at Idaho Springs and Boulder, Colo., crowds recently watched tournaments in which miners, armed with tough drills and heavy hammers, bored holes in huge slabs of native rock. The winner of such a contest is the man who cuts deepest hole in ten minutes. In "single jack" drilling, the contestant works alone, holding the drill with one hand and striking it with a hammer held in the other. "Double jack" drilling requires two men, as illustrated, one to guide and turn the drill and the other to swing the hammer. Each half minute, the men change places. So expert are some of the miners that they can change places without losing a second.

COVER CAR'S HEADLIGHTS IN AIR RAID

Tubes used to mask auto's headlight during a mock air raid

TO MASK the movement of automobiles while a mock air raid was in progress on a recent night in Tokyo, Japan, drivers were required to equip the headlights of their cars with blinders. The hoods devised for the purpose resembled the sawed-off ends of torpedo tubes. Cut obliquely, they effectively prevented the headlight rays from being seen from above, confining the light to the road ahead of the vehicle. Preparations for the raid were elaborate and conditions of warfare were simulated with great realism.



Top, streamlined form, and bottom, cone in air current to show wind resistance

SMOKE AIDS STUDY OF STREAMLINE PRINCIPLES

PRINCIPLES of streamlining are strikingly demonstrated by an exhibit installed recently at the Franklin Institute in Philadelphia. Interchangeable models of various sizes and shapes, whose wind resistances are to be studied, are mounted on a stand placed before the discharge orifice of a wind tunnel. When a stream of chemically generated smoke is released into the air stream, the eddies and turbulent air currents created by non-streamlined designs, which cause air drag upon airplanes and automobiles in motion, are made clearly visible. With proper lighting the apparatus also lends itself to unusually clear photographic studies, as shown in the two examples above. One reveals the smooth flow of air around a streamlined form, and the other the swirls and eddies about a cone.

LAMP ENCIRCLES TOOL

USING a ring-shaped lamp bulb, a new flash light recently developed in Germany furnishes illumination for a score of delicate tasks. The strange bulb resembles a short section of pipe, with the filaments contained within the circular walls, and its central hole serves as a socket for a pencil, surgical knife, pincers, or screw driver. Thus the beam of light always follows the instrument, assuring perfect illumination, as shown above.

A. V. Muzzey (with goggles) and his ground assistant, exhibiting a sack of eggs lowered to earth, and a live chicken hauled aloft in a successful test of the flyer's new pick-up system

New Pick-up System
FOR SPEEDING PLANES

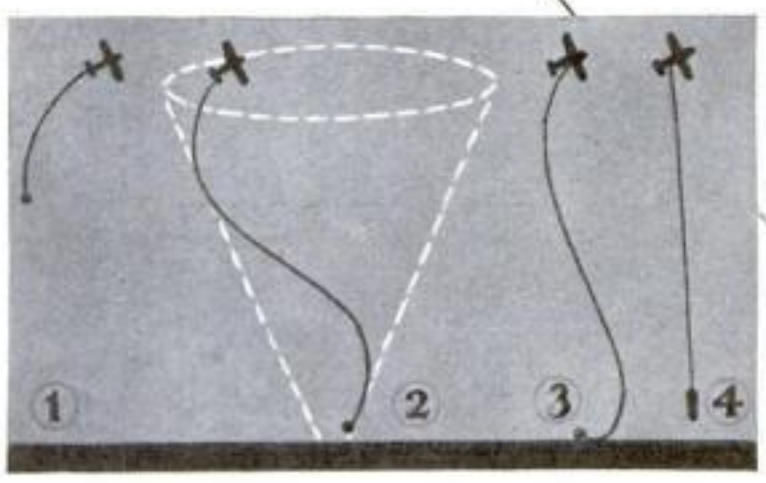


Diagram at left shows how the plan works. 1. Starting to lower the cable. 2. Lengthening cable takes spiral form, its sweep narrowing near the end. 3. Plane still circling with end of cable on ground. 4. Lifting the load

A SCIENTIFIC stunt devised by a western aviator, makes it possible for an airplane flying a quarter of a mile high to pick a man off the ground and haul him safely aloft. The scheme is proposed as a means of rescuing castaways, stranded explorers, passengers on sinking vessels, and any others cut off from ordinary aid. In addition it would permit dropping or picking up mail and supplies of any kind from the air.

The pick-up plane circles lazily high above the chosen spot and a long, weighted cable is lowered. It first bows outward, but as it lengthens it assumes a spiral, or corkscrew, form due to air drag. When the weighted end reaches earth, it is swinging in a circle of less than ten-foot diameter. Thus it can easily be grasped and fastened to any desired object. The plane, gradually straightening its course, hauls up the cable and the load attached to it, and flies on.

A. V. Muzzey, veteran barnstormer and originator of the novel pick-up idea, recently demonstrated its feasibility in a practical test at Tulsa, Okla. Circling an air field at 1,500-foot altitude, he lowered a sack of eggs safely to the ground, and hauled aloft a live chicken that a ground assistant attached to the cable in exchange. A five-pound sack of sand served as ballast for the end of the cord, and a red bathing suit made a conspicious marker to aid the pilot in lowering it accurately. Later, he and an observer repeated the stunt by dropping and picking up a 100-pound sandbag. A hand winch was used to handle the cable in these tests, but Muzzey plans to equip a plane with a power winch driven from the craft's motor before attempting to duplicate the feat with human freight which he maintains is entirely practicable.

Artist's sketch shows how arctic explorers might be rescued or supplied with food by a plane

How to Build a "Sky Globe"

WHICH POINTS OUT ANY STAR YOU NAME!

By
GAYLORD JOHNSON

•

STARS and the principal star groups are learned easiest by having a star-wise friend point them out to you.

"There is Vega," he says, pointing at it with his finger. "With the little group of five fainter stars near it, it forms the constellation called Lyra, or the lyre. And there is Regulus, the principal star in the group called Leo, or the lion."

But in case you haven't a friend with star lore, the next easiest way is to use a sky globe. With its aid, you need to know nothing about the stars in order to find all the principal ones. The sky globe will point them out to you infallibly and show you just what their constellations look like in the sky at any time of the year.

The sky globe is almost as easy to build as it is to use. You begin with a cheap geography globe such as is sold in stationery stores. I used one five and one-half inches in diameter that cost twenty-five cents for the model shown in the photographs. It is made of lithographed tin, but one of cardboard would have done just as well. When you obtain the globe from the store, it will be mounted either in a semicircular frame attached to a base, or on a stiff wire axis which is twisted below into a ring upon which the globe stands.

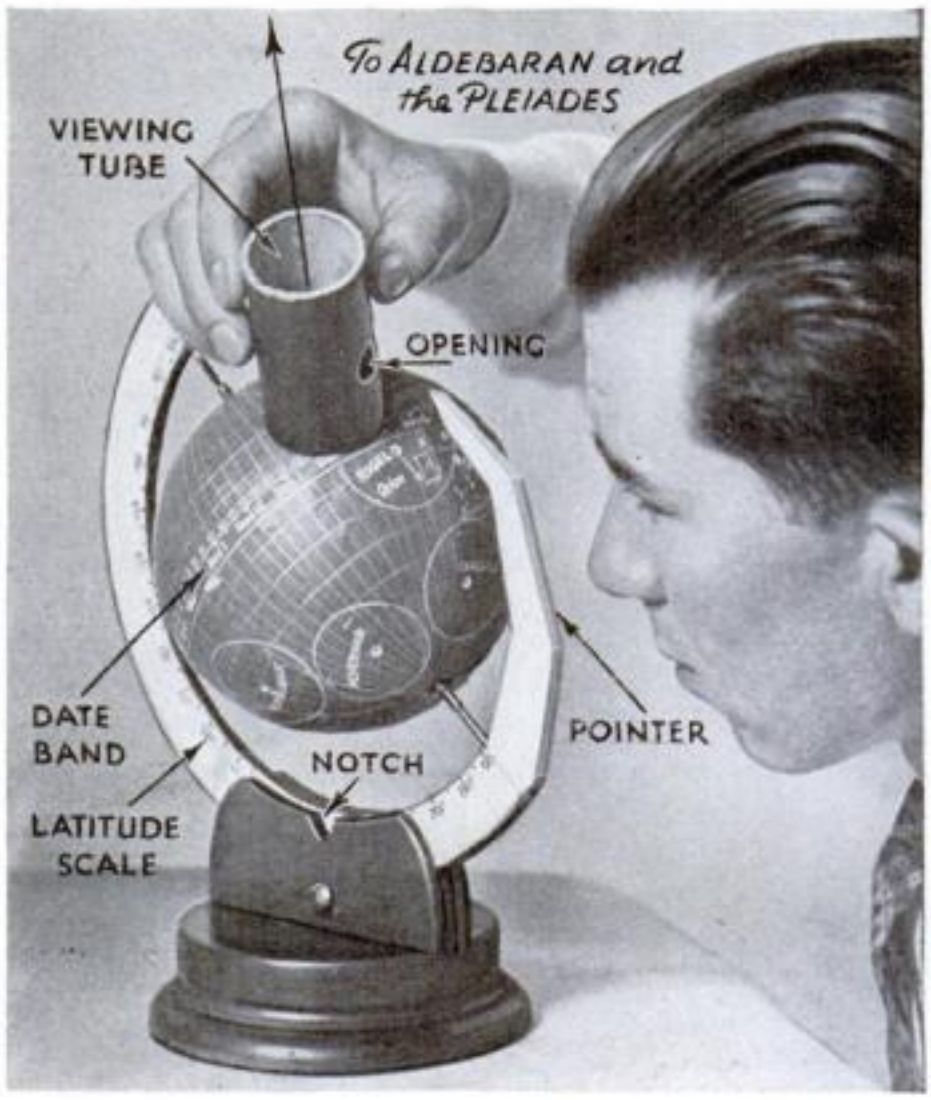
In either case, the globe must be remounted into a standard which will allow the slant of its axis to be adjusted in accordance with the latitude of your home.

The semicircular frame and its supporting pieces can be cut with a scroll saw out of three-ply paneling. A small bolt through the supporting pieces serves to clamp the semicircular piece in position at the correct slant. A notch cut in one of the outside supporting pieces reveals the latitude figures as the frame is slid in its supports. The circular base is easily turned out of plank on a lathe or it can be left square if no lathe is available.

The axis of the globe turns in two small holes drilled edgewise through the wood of the semicircular frame. In the case of the sheet-metal globe which I used, the original axis consisted of two half-inch studs riveted into the sphere at its poles. I left these undisturbed, and extended them by soldering on two large brad nails while the globe was held in position, with the nails resting in their bearings. If you use a pasteboard globe having a continuous wire as an axis, the wire of the base support can be straightened out and enough of it used to extend the axis. The upper end of the axis does not extend entirely through its hole in the semicircular frame. The upper half of this hole is left as a socket for a stud on the bottom of the viewing tube. This stud can be made from a nail of the same diameter as the axis wire of the globe.

The lower end of the semicircular frame is extended through another quarter circle and filed sharp to serve as a pointer for indicating the dates lettered along the sky globe's equator.

When the frame and base are complete, and the globe is fastened upon its axis,



When the globe is set with the pointer at the current date on the equator band, and the viewing tube is placed at the proper point on its surface, the star or constellation you wish to see will appear through the hole at the side. Since two mirrors are used, the star groups are not reversed in the image, but appear in the same position as if viewed directly

SETTING GLOBE BY POLESTAR

Above, testing the adjustment of the sky globe by placing the viewing tube in line with the polar axis and looking for the polestar in the mirror. Left, the viewing tube detached from the globe to show the stud that is inserted in holes punched in the globe at the positions of the stars. The stud projects about half an inch

you are ready to make its sky-map covering and glue it upon the spherical surface.

The length of the date band along the equator should be three and fourteen hundredths times the diameter of the globe. With the five and one-half inch globe I used, this was seventeen and one-fourth inches.

The sky-map covering for the globe can be copied and enlarged to the correct size from the diagram plan shown with this article, by photography or with mechanical drawing instruments.

When you have made your enlarged paper map, the next step is to cut away the waste paper from between the gores of the pattern. You can either cut out each gore separately, or leave them all attached by the date band running across their middles.

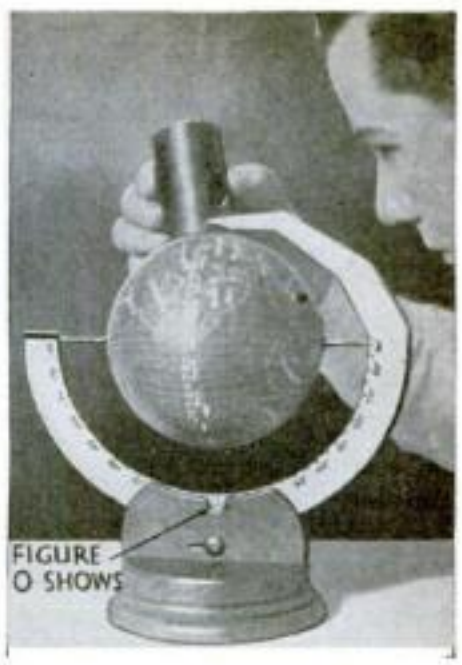
Then glue the gores into position on the globe's surface. Attach each glue-covered gore first at the equator and then smooth on gradually toward the poles. You may need to make a few snips with scissors along the edges of each piece, in order to smooth the paper down flat upon the curving surface. You will also need to cut the pointed ends to fit around the axis at the poles. After the glue is partly dry, an ivory paper knife helps to iron out little irregularities along the seams.

When the globe is covered smoothly, take a sharp center punch and drive a small hole through the center of each large white dot which represents a principal star. These holes should be just large enough to fit the nail stud which protrudes from the bottom of the viewing tube.

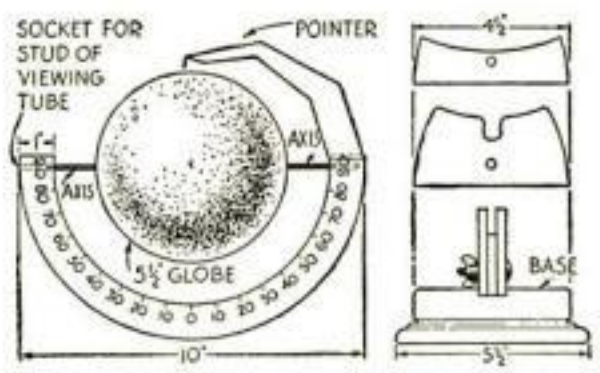
One more thing remains to be done before the sky globe and its supports are complete. You will need to add a latitude scale to the semicircle. This can simply be copied from the protractor in a drawing instrument set. It is numbered in both directions, from 0 degrees at the equator to 90 degrees at each pole. When this is lettered on Bristol board, it should be glued to the wooden frame as shown in the photos. Then set the circle so that the figure corresponding to your latitude appears in the notch on the support.

If the sky globe were to be used at the north pole, it would have to be adjusted like this, with the latitude figure ninety degrees

In the latitude of Buenos Aires, South America, the globe would be set with its northern axis tilted thirty degrees below horizontal



If used on the equator (latitude zero degrees) the globe would be set with its axis horizontal, the figure O appearing in the notch



Plan for making globe frame and base. The latitude scale is drawn upon Bristol board

The globe now turns freely in its support, with the date band along the equator running under the pointer. As you turn the globe over from right to left, counterclockwise, the dates succeed each other in calendar order.

Place the correct date under the pointer, and the upper half of the sky globe will then indicate the positions of all stars above the horizon in your latitude at 9 P.M. on that date. If you are observing at 10 P.M., bring a date fifteen days later in the year under the pointer. You can do this because there are twenty-four of these fifteen-day divisions; each one is therefore equal to an hour in the day. The appearance of the sky at 10 P.M. will accordingly be the same as the appearance fifteen days later at 9 P.M.

In the same way, the smaller divisions, labeled 20, 40, and 60, can be used either as five-day intervals or as twenty-minute intervals. To illustrate: Turn the globe until the pointer *(Continued on page 129)*

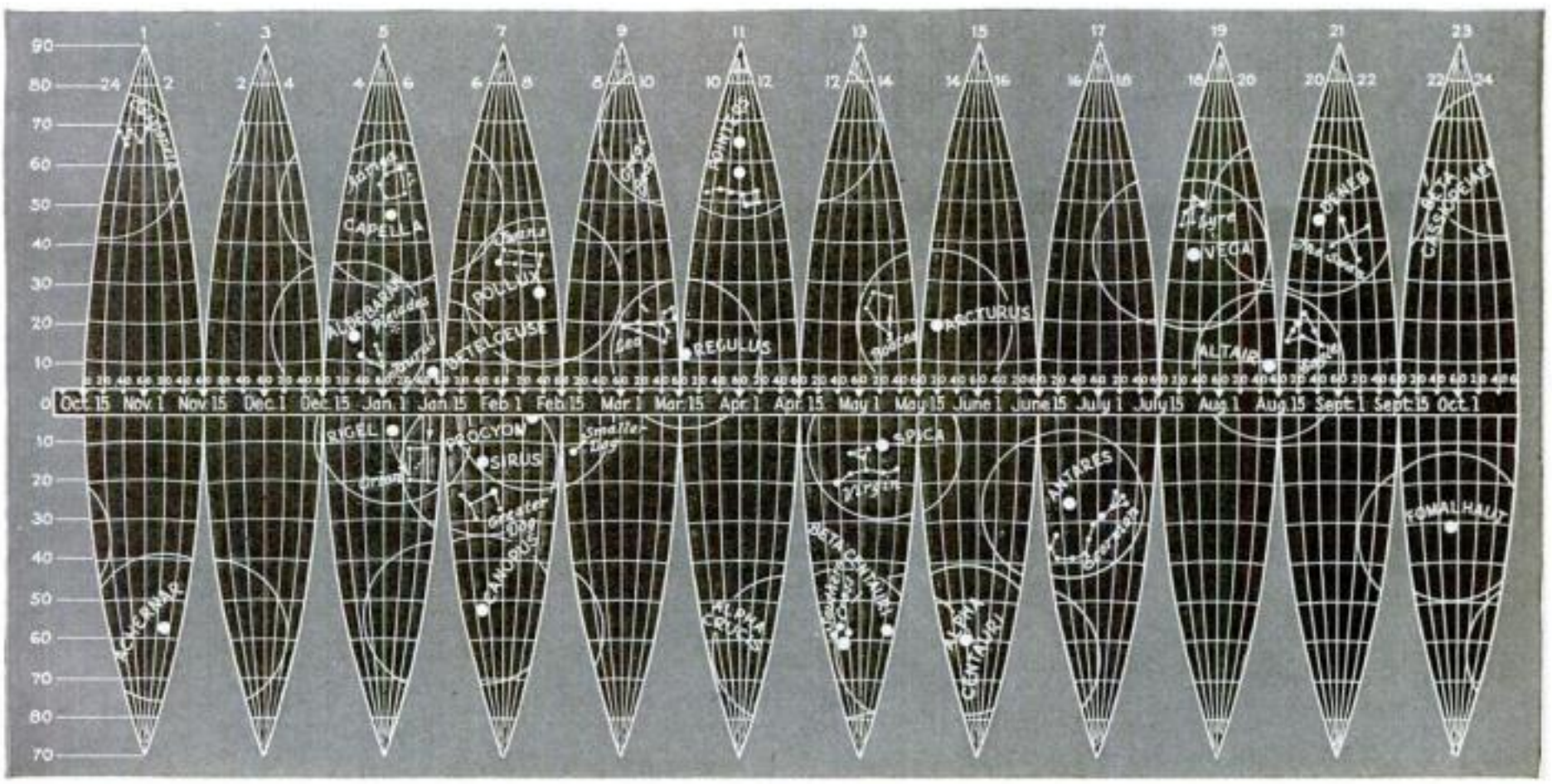
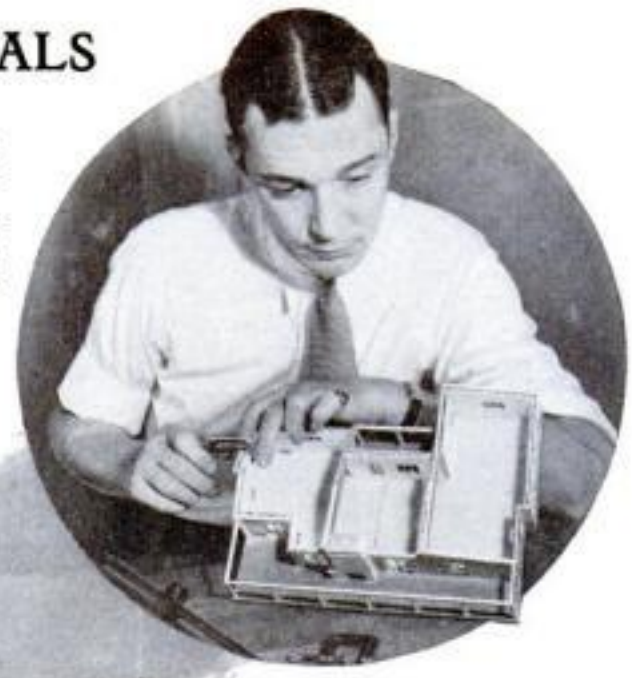
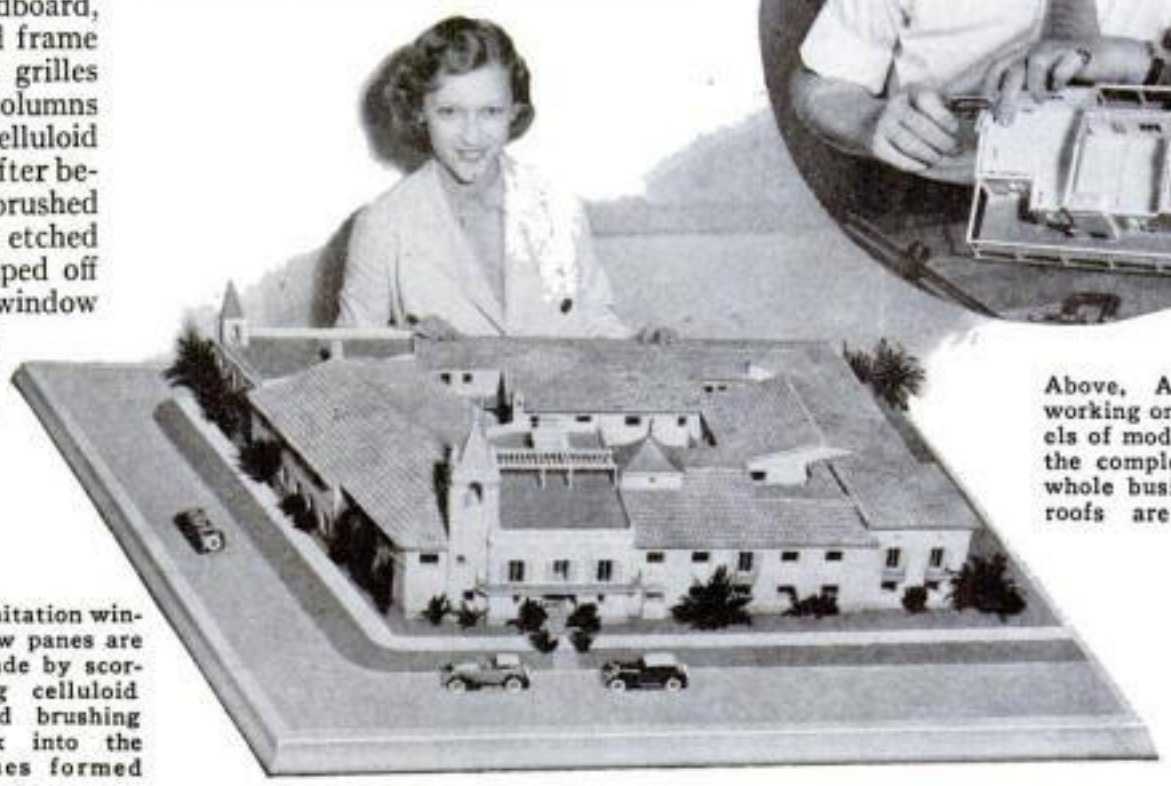


Diagram plan showing how to lay out the star map for your globe. The twelve gores are cut apart and glued in order on the sphere

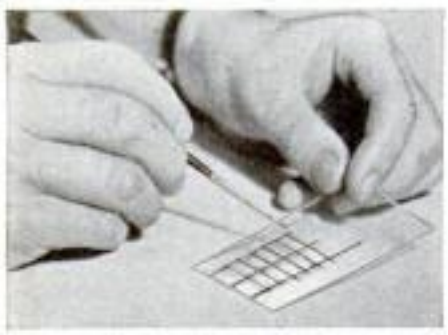
MODEL HOUSES MADE OF ODD MATERIALS

TO SHOW what projected structures will look like when completed, a Southern California architect and real estate dealer has devised a way to make faithful small-scale color reproductions of buildings out of cardboard, celluloid, and liquid rubber. The cardboard, cut to scale, is glued to a balsa wood frame to form walls, cornices, balconies, grilles and doors. Rafters, trellises and columns are also fashioned from balsa. Celluloid is used to represent window glass. After being scored with a metal point, it is brushed with ink. The ink remaining in the etched lines after the surplus has been wiped off gives a realistic appearance of window panes. Tile roofs for the models are made from liquid rubber. This is poured into clay molds and, when the rubber hardens, the imitation tile may be cut to fit any section of roof. After the house has been completely assembled, it is painted in appropriate colors. The models give a more nearly accurate idea of the buildings than blue prints.





Above, Arthur Winslow working on one of his models of modern homes. Left, the completed model of a whole business block. The roofs are liquid rubber



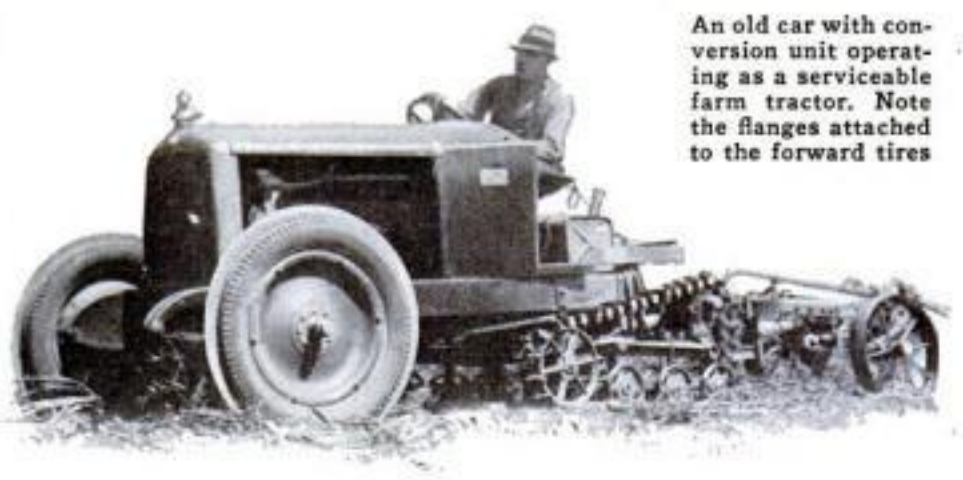
Imitation window panes are made by scoring celluloid and brushing ink into the lines formed

VACUUM CLEANER USED ON STREETS OF CITY

AN innovation in street-cleaning equipment is a motor-driven vacuum cleaner just introduced by the Middlesex, England, County Council. Illustrated above, the machine resembles a garden cultivator, with four supporting wheels and long handlebars. The powerful vacuum blower is driven by a small gasoline engine which is mounted directly upon the cleaner. Fuel for the engine is contained in a tank between the handlebars, and a throttle attached to one grip, as on a motorcycle, controls the power of the suction. Dirt sucked up by the cleaner is blown into a container at the back of the machine.

UNIT TURNS OLD CAR INTO A TRACTOR

TURNING an old automobile into a serviceable, crawler-type farm tractor, at a cost said to be less than that of an average team of horses, is made possible by an inexpensive conversion unit recently placed on the market. The attachment comprises a pair of endless tracks mounted on a frame, and is easily connected to a four or six-cylinder car by cutting off the original frame and shortening the drive shaft. According to the maker, the tractor will then perform all the work required on a small farm. The front-wheel tires of the car are utilized by riveting steel flanges to the casings, in such a way as not to damage the inner tubes. The flanges tend to hold the machine to the furrow, assuring straight work in soft ground. No changes in the power plant are required except the addition of a heavy-duty air cleaner to prevent dust damage, and in some cases increased fan speed for more efficient cooling of the engine.



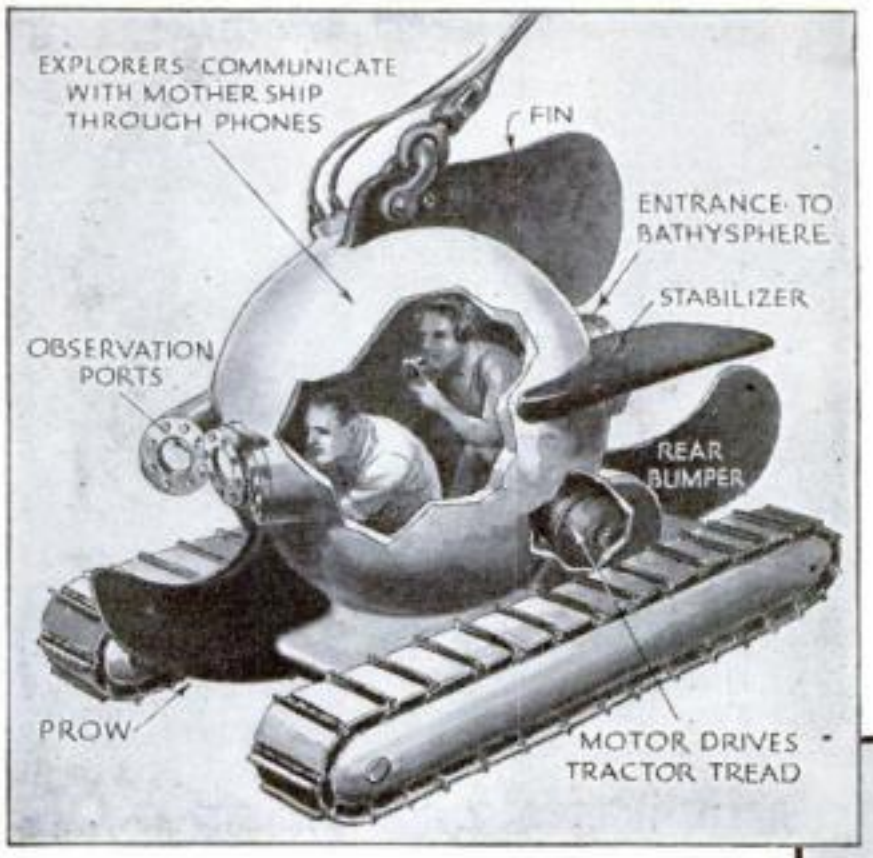
An old car with conversion unit operating as a serviceable farm tractor. Note the flanges attached to the forward tires

TYPEWRITER ALIGNS LEDGER ENTRIES

SELECTING the proper columns for making bookkeeping entries is a task performed automatically by a dial on a new German typewriter. The unusually wide carriage of the typewriter takes a wide ledger sheet with ruled columns. To align any one of these columns for making an entry, it is necessary only to use one of the corresponding finger holes contained in the dial. A toothed bar on the front of the typewriter carries attachments for totaling up the columns, and an extra row of keys bears the special symbols required.

Stalk Sea Monsters in Odd Craft

Mysteries of the Deep May Be Solved By New Invasion of Submarine Caverns

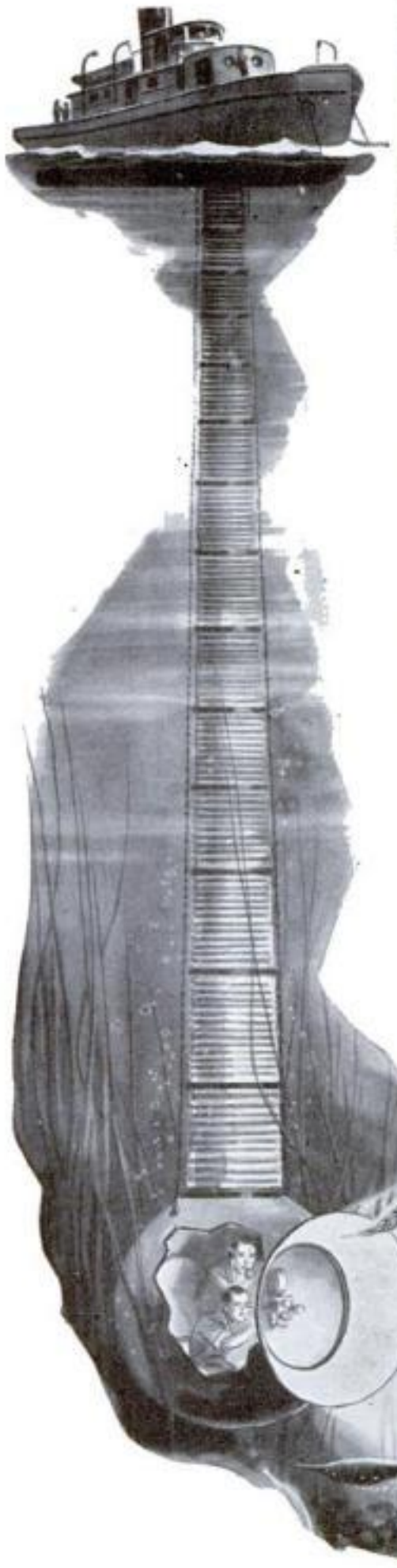


will be added to hold it steady in submarine currents, and a tractor tread is under consideration as a means of crawling along the ocean floor. Wooden framework may also be installed to prevent the thick quartz windows from shattering in the event of a collision with an undersea crag—an accident that would flood the ball and mean certain death to the occupant. With his "submarine chariot," Dr. Beebe plans to invade submarine caverns and grottoes on the ocean floor, hoping to obtain a better view of enormous, fantastic creatures he believes he has dimly glimpsed in previous descents.

Above, bathysphere in which Dr. Beebe made his record descent. Sketch shows how it may be fitted with a tractor tread

MANNING undersea observation posts that employ the strangest of mechanical equipment, naturalists soon will attempt to solve perplexing mysteries of the deep. J. E. Williamson, pioneer photographer of life beneath the waves, will stalk the famed "sea monster" said to inhabit the waters of Loch Ness, Scotland, with the aid of his submarine exploring tube. Thus he plans to settle the controversy as to whether the creature is a sea serpent of fabulous size, as some observers insist; a large whale, as naturalists have tentatively identified it from long-distance photographs (P. S. M., July, '34, p. 18); or, as Williamson himself proposes, a huge squid that, in its infancy, may have entered the inland lake through the narrow channel that connects it with the sea. From the deck of a drifting boat, he will descend an open-mouthed, jointed steel tube to an observation chamber hung at its bottom, where he will peer through a porthole for signs of the monster. Williamson hopes to get a close-up photograph that should show exactly what it is.

Meanwhile, Dr. William Beebe, noted explorer and holder of the world's deep-sea diving record, plans to remodel the water-tight metal globe or "bathysphere" in which he has descended more than 2,500 feet below the surface. Fins and a tail



Left, how J. E. Williamson, undersea photographer, plans to stalk the "monster" of Loch Ness with his submarine observation tube. He believes it to be a huge squid

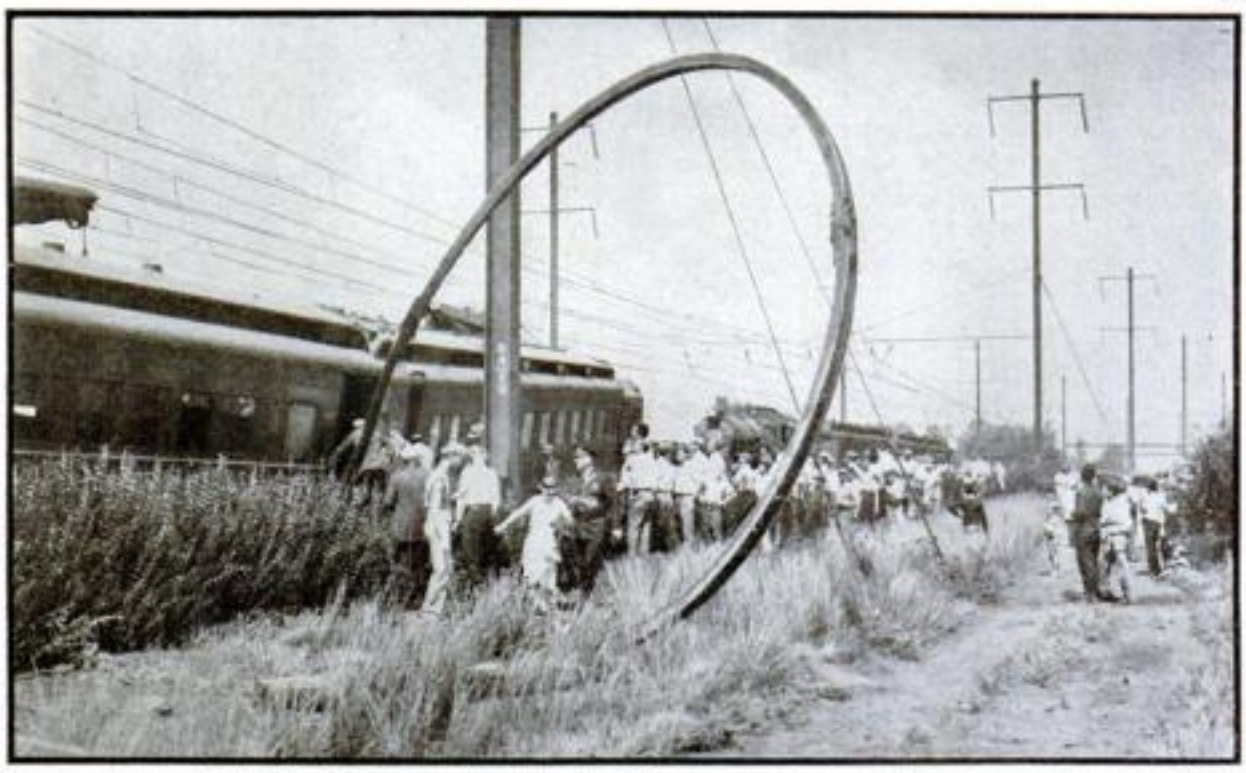
PHOTO DEVELOPING TANK IS OF STAINLESS STEEL

ESPECIALLY suited for the new grainless developing process (P.S.M., Oct. '34, p. 78), a new tank of stainless steel permits photographed film to be wound on the reel without the use of a protective apron. Being welded, the tank is perfectly smooth inside and out. It must be loaded in the dark, but light may be used in pouring in the developer. The stainless steel prevents fogging, which occurs when film being developed by the grainless process comes into contact with ordinary metals.

STREAMLINED TRUCK BUILT FOR SPEED

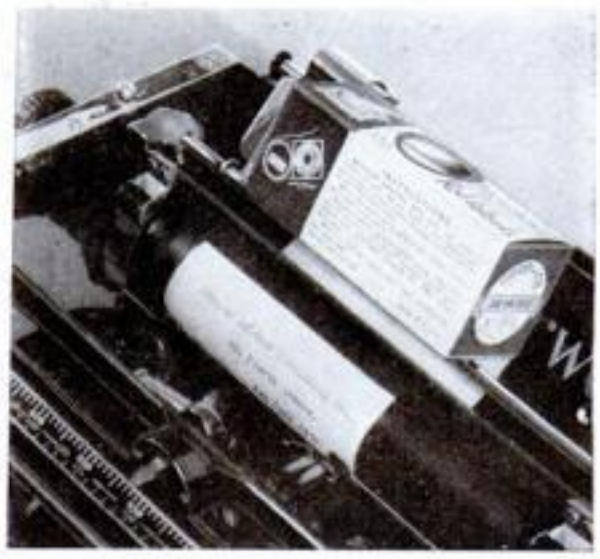
ITS squat design suggesting a helmeted knight in armor, a streamlined motor truck is England's latest contribution to fast highway transport for freight and express. The angles, jutting fenders, and straight lines typical of ordinary trucks have been eliminated in an effort to lessen wind resistance and thereby increase speed. Trucks built along the new lines are also said to take less road room than do conventional trucks of like capacity. The unusual appearance of the new streamlined truck, as viewed from the front, is shown in the photograph at the right. Note the absence of all air-resisting projections found on most trucks.

WRECK BENDS RAILS IN TWO-TON HOOP



Steel hoop formed by three rails which were plowed up and twisted by the impact of a wrecked train

A DERAILED express train can bend massive steel rails into a hoop as easily as a basket weaver bends a reed, as a recent freak accident showed. When a Pennsylvania Railroad flyer speeding from Washington to New York left the track near Bristol, Pa., the coaches bumping along the crossties, ploughed up three rails and twisted them into the giant ring pictured above. The twisted rails made a circle nearly thirty feet high. The steel in the giant hoop weighed more than two tons.



TYPING OF LABELS MADE EASY BY NEW PACKAGE

AN INGENIOUS new package permits continuous-roll labels to be written on an ordinary typewriter without special attachments. The package contains a roll of gummed paper, rouletted to form 250 labels. To start the roll through a typewriter, the package is laid upon the paper rest of the machine and the platen turned. After a label is typed, it is easily detached from the roll. The portion of the roll drawn from the package but not needed may be rewound on the roll.

FUSE TELLS WHEN IT IS BURNT OUT

The sign changes to "NG" when fuse burns

THE necessity of unscrewing every fuse in a box, to locate one that has blown out, is eliminated by a recently marketed fuse. When the fuse is in good order, the letters "OK" are visible through a peep hole in the cap. When the fuse burns out, these letters disappear and the sign "NG" takes their place. Danger of shock in removing the fuse is obviated by two non-conducting porcelain knobs.

VACUUM HOLDS AUTO LUGGAGE CARRIER

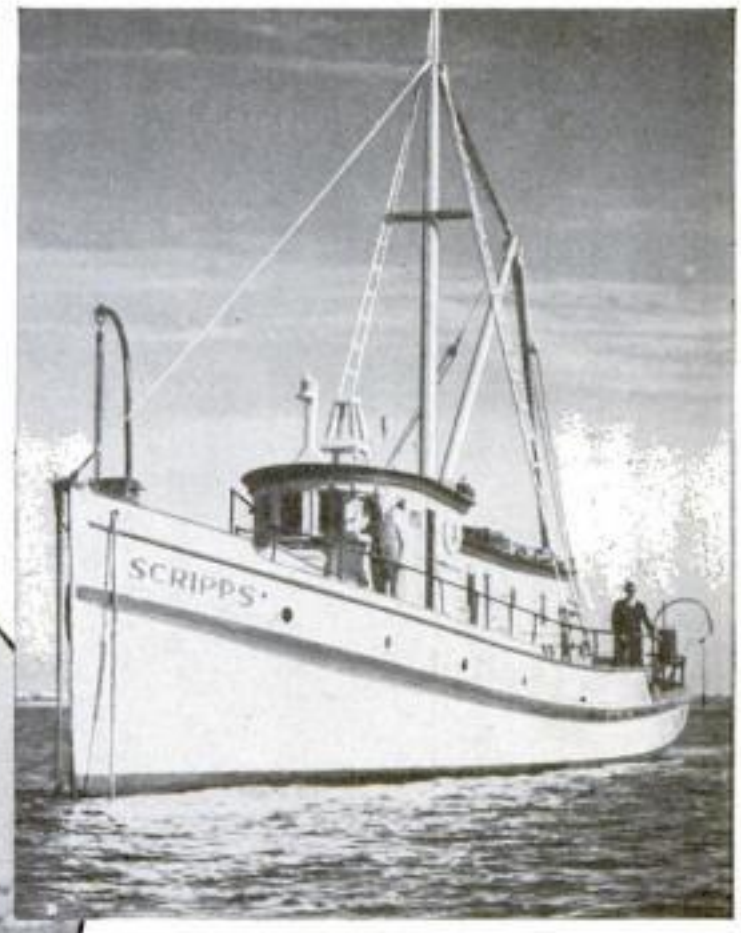
A NEW auto luggage carrier is attached by merely laying it upon the roof of the car and connecting a piece of rubber tubing to the vacuum line of the windshield wiper. The resulting suction causes four vacuum cups on the legs of the tubular steel frame to grip the roof firmly and hold the carrier in place. When the engine is shut off, automatic check valves in the line maintain the vacuum. The carrier is large enough to hold ten suit cases. The carrier, also, can be converted into a table.

Suction from intake manifold holds luggage carrier in place

Strange Robots Explore Ocean Depths

MECHANICAL aids that descend thousands of feet into the sea are revealing, for University of California oceanographers, new and amazing secrets of deep-sea life. Great watery deserts in which no life can exisit have been discovered by the mechanical assistants. They have found unsuspected currents that reverse their direction without warning and have brought up strange plants that can live only fifty to 100 feet below the surface. On a recent expedition that covered a route from the Aleutian Islands to Hawaii, the scientists, with the help of the mechanical aids, took hundreds of samples of sea water and minute marine life. They analyzed countless samples of bottom ooze and took frequent temperature readings. The water samples were taken with strange bronze bottles. These containers, fastened top and bottom to cables, were lowered to the required depth. A lead washer, or "messenger," was allowed to slide down the cable. The messenger disengaged the top attachment and let the bottle turn end up, taking a sample of water and then sealing itself again. Odd inverted cones of canvas were used to bring up samples of minute sea life, or plankton. The cones were carried to great depths by weights, where they filtered the organisms out of the water and brought them to the surface. Specimens of the ocean floor were gathered with the help of miniature dredges with jaws like opened clam shells. With the aid of these appliances, the scientists have obtained a comprehensive picture of the forms of ocean life.

Right, mechanical bottle that fills itself miles below the surface of sea

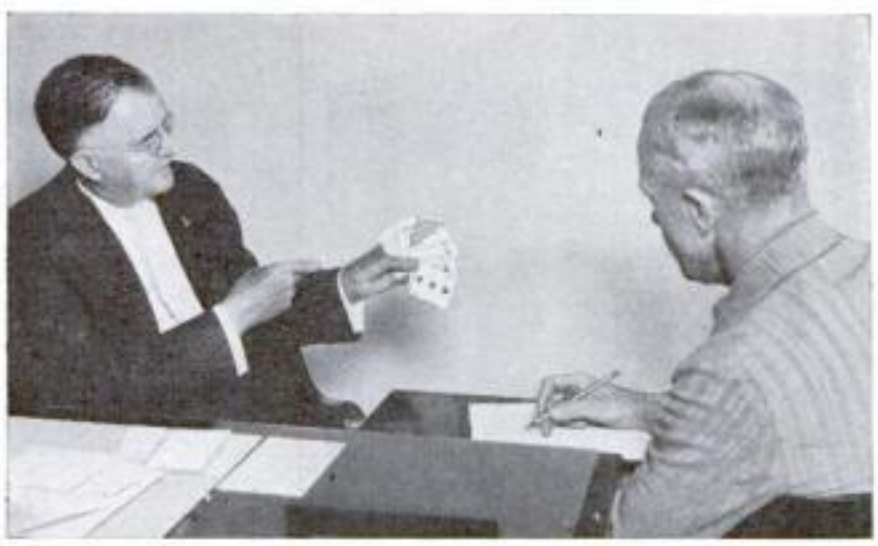


Survey boat used by scientists of the University of California in studying ocean life and currents. It is equipped with elaborate devices

Above, conical net bringing up tiny sea animals. Left, lowering a dredge that bites sample from the floor of the sea

MAGIC IS HOBBY OF U. S. OFFICIAL

AFTER a day of concentration upon the realities of figures, William W. Durbin, register of the U. S. Treasury in Washington, finds relaxation in magic. Durbin has devoted his spare time for fifty-eight years to this hobby and has mastered 3,000 conjuring tricks. Many of the most mystifying illusions practiced by professionals were originated by this skilled amateur. For giving performances, he has built his own theater, seating 125 persons, on the lawn behind his home. Durbin's magical equipment is so extensive that the cases and trunks containing it fill two large rooms. For the last ten years, he has been president of the International Brotherhood of Magicians, an organization in which 5,500 magicians, living in every country in the world, hold membership. He won this unusual honor as a tribute to his skill and originality in magic.



William W. Durbin, register of U. S. Treasury, demonstrates for a friend one of the hundreds of card tricks he has at finger tips

His hobby has won Durbin the presidency of the International Brotherhood of Magicians

SOLDIERS SHOOT AT CARDBOARD ARMY

A "GHOST ARMY" of cardboard figures advanced through a wooded section near Doeberitz, Germany, the other day. Drawn on wires, the effigies provided realistic targets for Reichswehr troops engaged in rifle practice, as shown above, and gave the marksmen a chance to test their skill under conditions like those of real warfare.

FLAT PENCIL CAN BE USED AS A BOOKMARK

SO FLAT and wide that it can be slipped between the leaves of a volume without damaging the binding, a newly introduced pencil serves as a handy bookmark. It also provides the reader with a convenient means of checking off interesting passages, as shown in the illustration above, or of taking down notes as he goes along. When he closes the volume, the pencil with its knotted tassel keeps his place until he picks up the book again.

USES ESCALATORS ONLY

ESCALATORS will be used exclusively to transport customers from floor to floor in a five-story department store now being built in Chicago. Eight escalators will be installed, and elevators will be used only for employees and freight.

TOY STEAM LOCOMOTIVE FIRED BY ELECTRICITY

REAL steam, produced safely and without odor, operates a new toy locomotive for 0-gage electric track. When water has been added as shown above, an electric heating element in the boiler builds up steam pressure in three to eight minutes. The engine then puffs along as realistically as any boy could demand, starting and stopping as current in the track is turned on or off. One boiler filling is enough for a half-hour run.

PERMANENT WAVE IS GIVEN BY RADIO

The curlers of this new permanent-wave outfit are heated by radio, thus doing away with the cumbersome connecting wires

WOMEN can now obtain permanent waves by radio. The apparatus just developed for the purpose eliminates the heavy electric wires that are part of the ordinary permanent-wave machine, so that the patron need not remain in one spot. Curlers affixed to the hair contain heat elements operated by the radio waves transmitted from a high-frequency radio set nearby. The temperature of the curlers can be regulated by varying the intensity of the waves.

Prehistoric animals and men modeled in metal for educational use

MODELS SHOW PREHISTORIC LIFE

TINY figures of men and beasts of past ages, expertly fashioned in metal, are now available in sets for classroom instruction, enabling school children to visualize the appearance of such fearsome creatures as dinosaurs, pterodactyls, saber-toothed tigers, and mastodons. Blind pupils may learn by fingering the figures.

SCREW-DRIVER ATTACHMENT DRILLS HOLES

WHEN hooks or screws are hard to start, a new attachment for the screw driver comes to the rescue. Slipped over the blade, it serves as a drill to make a preliminary hole with a few quick twists. The attachment fits screw drivers of various sizes, and is of tool steel.

The line of traps at the Grand American Handicap Tournament, held annually at Vandalia, Ohio. Trap-shooting enthusiasts come from all over the country

How Shotgun Champions ....BATTLE FOR THEIR CROWNS

J. R. Jahn, the 1934 champion in the professional class. The professionals represent arms and ammunition makers

Trap shooters waiting for their turn. Each trap serves five contestants, who shoot at the targets in rotation

WHILE the Grand American Handicap Tournament, held each year at Vandalia, Ohio, is primarily a battle of shotgun champions, it is more than a shooting match. It is a carnival where any one interested in guns and shooting can have the time of his life, even if he does not follow closely the activities of the experts who are trying to smash clay birds along the line of traps.

A trap-shooting tournament seems a matter of paradoxes, particularly to one not familiar with the sport. It is a contest in which lucky amateurs are awarded cash prizes, while professionals do not shoot for money. Breaking clay birds with a shotgun seems to be an art that is not greatly affected by age or other limitations. At Vandalia you may find a comely young woman and a grandmother of uncertain age firing side by side with a thirteen-year-old boy and a man who has lived beyond his three score and ten years. One Grand American Handicap was won by a boy who looked barely able to hold his shotgun. This year a woman, Mrs. Lela Hall of East Lynne, Mo., won third place. This is the highest rating any woman ever attained in the Grand American.

Elmer E. Shaner, who has been called the granddaddy of American trap shooting, and who has welcomed contestants to the big shoot almost every year that it has been held, declares that trap shooting holds second place in American sports, being topped only by baseball in popularity. Although the 1934 contest at Vandalia was known as the thirty-fifth annual Grand American Handicap, Shaner has attended forty-five of them, the first ten having used live birds for targets, and the subse-

By WALTER E. BURTON

Mrs. Lela Hall, who took third place in the 1934 contest. This is the highest rank ever won by a woman in the tournament, though many of them shoot

Below, interior of the trap house from which the targets are thrown. This trap is being set to throw two of the targets at once for a match of doubles

quent thirty-five the familiar "fruit jar cover" clay birds.

For a long time, trap shooting was supported entirely by manufacturers of ammunition and guns. They banded together and provided the money and equipment for the contests. Shaner used to tour the country and organize such contests, carrying as much equipment as a small circus. Then the time came when it seemed wise to turn the sport over to the amateurs. This was done ten years ago, and trap shooting is now a purely amateur activity.

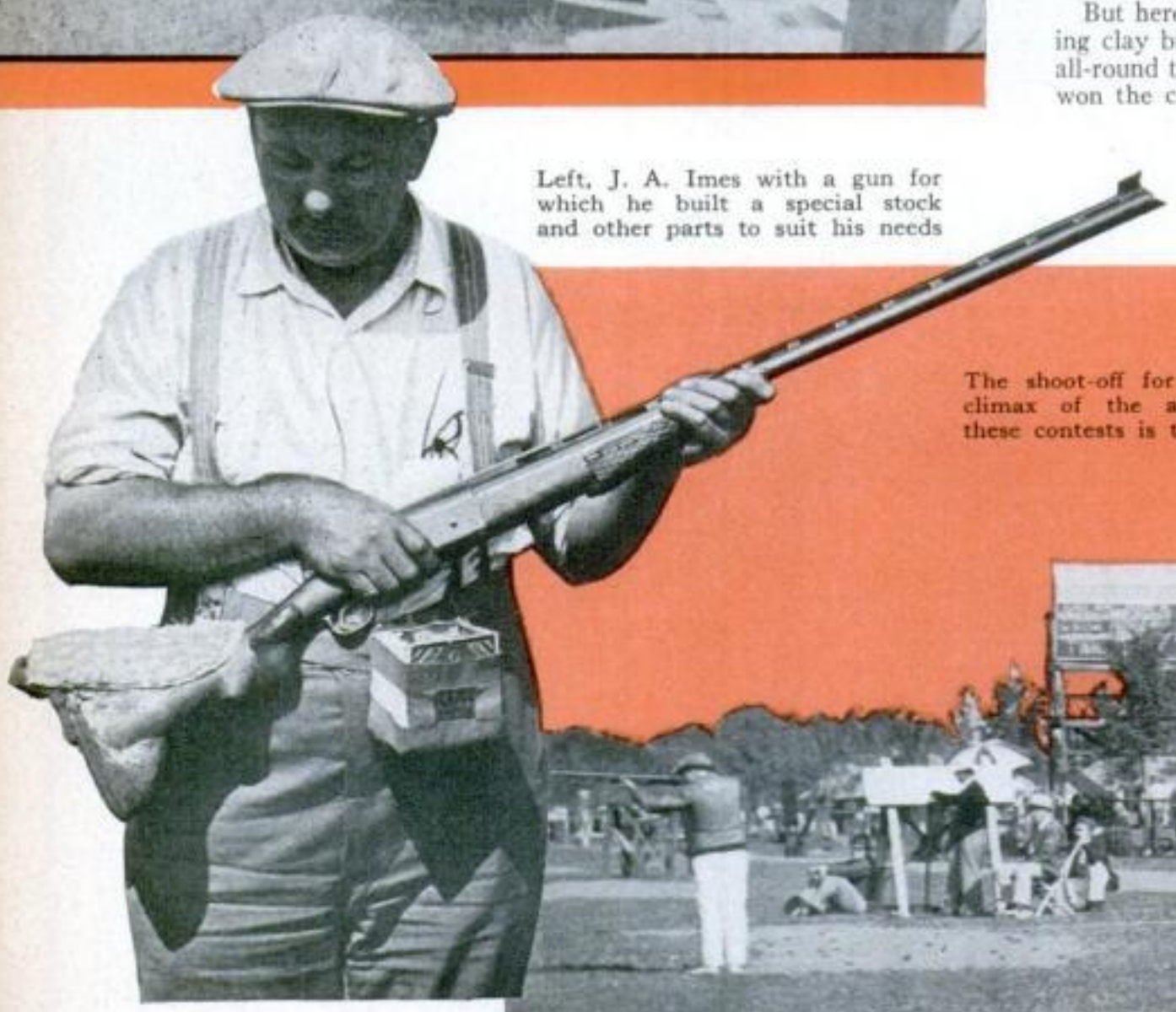
The 1893 Grand American Handicap drew twenty-one contestants. In 1929, the record year, there were 1,100 entries. General business conditions have had a marked effect on the sport in recent years.

Grand American Handicap week is the climax of a nation-wide series of shooting programs extending throughout the year. The men who take their guns to Vandalia represent the cream of American shotgun artists. For every man who becomes expert enough to shoot in the grand event of the year, there are dozens who must be content to stay at home.

All of this activity, and particularly the handicap tournament, has had an important effect on the improvement of guns and ammunition, and of traps for throwing the clay birds into the air. Development of shooting equipment can be traced in the scores attained and in the distance handicaps imposed at various meets. In the old days, a man who broke ninety birds out of 100 was considered a wonder. In fact, the manufacturers used to give free shells to all shooters who made the remarkably high score of ninety-three. R. O. Heikes won the Grand American in 1900 with a score of ninety-one, shooting from the twenty-two-yard line. It was ten years before anyone broke 100, and then only from the nineteen-yard line. In 1926, C. A. Young, shooting from twenty-three yards, broke 100 birds. Lawrence Dana scored ninety-eight to win this year.

Improvement of guns and ammunition has reached a point where a contestant, to be in the running at all, must hover close to the century mark. The better equipment has made it necessary to move the gunner back a greater distance from the target. Today, it is not primarily a question of how many birds a shooter can break out of every 100 thrown, but how many he can bring down before making a miss.

But here is another paradox in this sport of shooting clay birds: Mark Arie, one of the world's best all-round trap shots, went to Vandalia this year and won the champion-of-champions contest and other honors with a gun he bought twenty-five years ago, and which he has used ever since. It was not considered an unusually fine gun when he bought



Left, J. A. Imes with a gun for which he built a special stock and other parts to suit his needs

The shoot-off for the year's championship crown is the climax of the annual tournament. Witnessing one of these contests is the greatest thrill of a trap shooter's life

it and was priced about the same as other shotguns of the day. Yet it has won him about $50,000 in cash and $150,000 in trophies during the twenty-five years that he has been using it!

One of the questions frequently in the minds of those who attend shotgun events concerns the origin of the clay-target idea. In pioneer days, shooters got plenty of practice bringing down ducks and other live birds, whether for food or for the sport of it. Then some one conceived the idea of releasing live birds, frequently wild passenger pigeons, from coops and shooting at them as they attempted to fly away. Killing birds with a shotgun seemed humane enough to followers of the sport. In almost every case, the bird was killed instantly or else missed entirely. Then there occurred a sudden change in public sentiment, and the shooting of live pigeons was criticized as cruel and was prohibited by law in certain states. So clay targets, tossed into the air by spring-operated traps, were substituted, and now are used universally. Clay birds provide all the thrills of actual hunting, and their use has done much to conserve natural game.

There are many things that lend a carnival atmosphere to the Grand American Handicap. First of all, there are the twenty-two traps, accommodating 110 shooters at one time. Six of these traps are used for practice, so that the number of contestants participating at one time in a main event is eighty or less. It is impossible to watch all of the traps at once, so each one has its little band of spectators. Any and all traps will provide thrills for the onlookers. There is an inexplicable fascination in watching five men shooting in turn at clay targets that rise, at the gunner's shout of "pull," from the concrete trap house. When two targets sail into the air simultaneously in the doubles matches, interest is even greater. But for real thrills, there is nothing to surpass a shoot-off for the year's championship crown.

Tiring of watching the field being sprayed with lead, the visitor seeks other entertainment. In Commercial Row, representatives of manufacturers of guns and ammunition display their wares, offer easy chairs and ice water, and act as general information dispensers. It is a tented community resembling a circus side-show.

Out in front of one tent a horned owl is doing a hula hula. Closer inspection reveals that it is mounted on a vertical rod, which can be swung from one side to the other by pulling a cord. The owl's head is pivoted, so that its movements give the effect of a grotesque dance. But he poses in his stuffed glory, not for entertainment, but for the highly useful purpose of trapping crows.

The mechanized owl is being demonstrated by George H. Garrison, representative of a gun manufacturer, who is interested in conservation work. In some sections, Garrison explains, there are so many crows that the existence of beneficial song and insect-eating birds is being threatened. So he sponsors crow-killing activities in such districts. He had the dancing owl constructed for the purpose of attracting crows, an owl being one of the best decoys. While a stuffed owl that does not move will cause crows to congregate within gun range, an owl that dances is many times more effective, he explains, in attracting the attention of curious birds.

Among the most popular attractions in Commercial Row are the shops of several expert gunsmiths who adjust trigger pulls and perform other repair jobs without charge. It is worth more than the price of admission to watch these experts at work, and they are seldom idle.

Most exhibits at the handicap tournament were guns. Many of the trap-shooting enthusiasts, women as well as men, spent hours inspecting the hundreds of shotguns on display, and doubtless wishing that they had money to buy a dozen of them. Then there were rifles, all calibers and sizes. There were trench and riot guns, and even small chromium-plated cannons. Inquiry revealed that the cannons are used as signal guns on yachts and elsewhere.

A tour of the gun exhibits was

A trap operator waiting for the signal to release the target. The shooter calls "Pull!" when ready

WHICH EYE IS "MASTER"?

Right, using the manuscope to test a shooter's vision. The object of this test is to measure the dominance of the "master" eye

This Unique Sporting Event Attracts Enthusiastic Followers from All Walks of Life

likely to give rise to the thought that trap shooting must be a costly sport. Several other observations, such as the quantities of shells being carried about by the ammunition boys, strengthened this impression. Old-timers at the shotgun game were prepared to do some explaining. Trap shooting, they pointed out, is a sport that is admittedly a luxury when followed full scale, but it is not more costly than many other sports.

The man who purchases costly guns and burns up ammunition at a great rate has his counterpart in the golfer who belongs to a club, owns a set of high-grade clubs, takes about 100 strokes for eighteen holes, pays a caddy a dollar for his services, and then has to buy dinners for his opponents when he loses. It costs the trapshooter about a nickel each shot. The golfer's expenses are about the same for each stroke.

But how about the duffer who plays public golf courses, carries his own clubs, and finds as many balls as he loses? Where can he find comparable sport in trap shooting? The advice of experienced followers of the shotgun sport is to get a .410-gauge gun and a hand trap that will cost two or three dollars. Shells for the gun run about two dollars a hundred, and targets can be obtained for a half cent each. Any bit of open country can be used as a shooting ground.

The Amateur Trap-shooting Association's plant at Vandalia has brought a new industry to the little village north of Dayton —lead mining. A mining engineer would be astonished at the equipment used—a road grader, blowing machine, and melting apparatus. The grader is employed to remove a thin layer of soil from the field in front of the row of traps, and the blower to separate the dirt from the lead pellets. The shot is then melted into 100-pound bars. One of the side-show attractions at the handicap tournament was a stack of these bars, weighing several tons, in the shell house.

It may seem like a waste of time to try to recover shot from a large field. But consider these facts: The last lead mining was done at Vandalia in 1928. Since then it is estimated, about 6,000,000 targets have been fired at, including those used in Ohio State and other competitions held at the range in addition to the G. A. H. Each shell contains about one and one-fourth ounces of lead shot, which gives a grand total in excess of 230 tons. Not all of this will be recovered, but it has been estimated that at least 150 tons, worth thousands of dollars, will be collected this year.

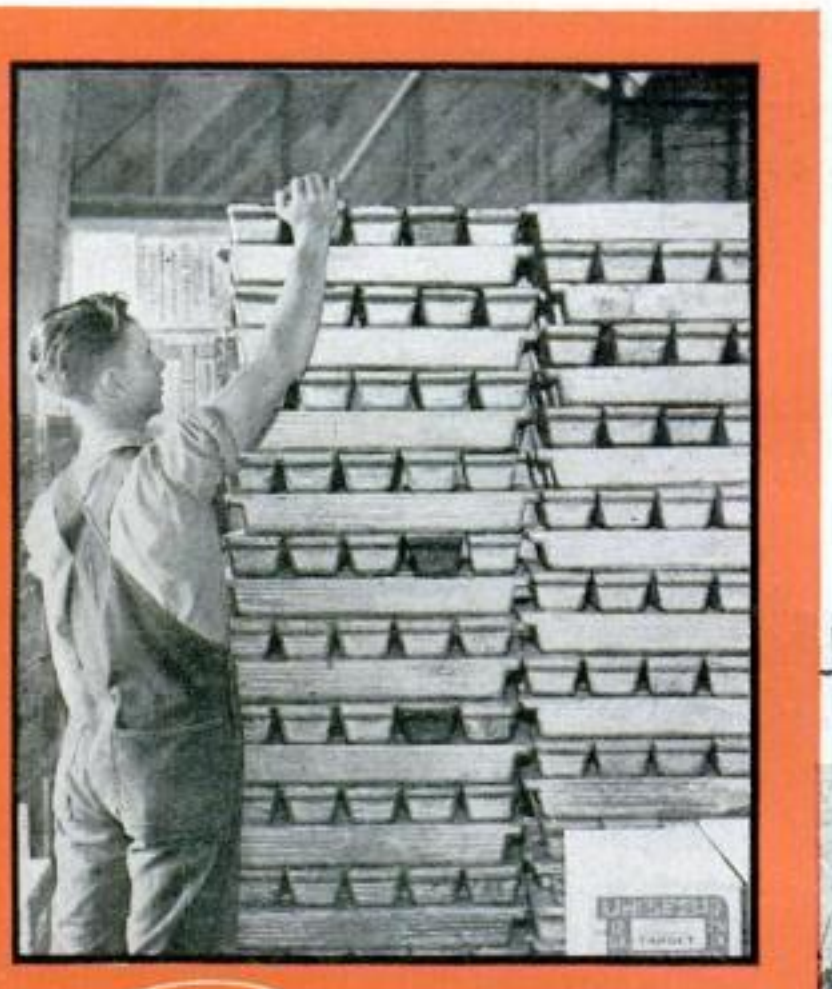
In all, the Grand American Handicap tournament would be worth the efforts involved in making it possible if it did nothing more than provide concrete evidence of the vastness of trap shooting as a sport, and the grip that it has on gun lovers of the country. The visitor who never before paid much attention to trap shooting is impressed by many things: the size and well-kept appearance of the permanent headquarters plant of the Amateur Trap-shooting Association; the camp, where visiting shooters from all parts of the country erect tents or anchor camp trailers; the fact that this is a sport in which a professional can become, without particular trouble, an amateur, and vice versa, a professional being a shooter who is connected with an ammunition company or other commercial organization interested in shooting equipment.

The visitor is struck by the fact that contestants will scrape their pennies together and travel thousands of miles to attend the tournament, one entrant coming this year from the Canal Zone. Whole families, each member completely equipped and an expert shot, trek across the continent to Vandalia.

Inquiry into the normal occupations of the hundreds of expert shooters who take part in the events of G. A. H. week reveal that they represent practically all walks of life. There are doctors, engineers, business men, workers in the trades. This year's champion is an oil driller by profession. Some competitors are better shots than others, but the system of handicapping arranges things so that all stand an equal chance to win valuable prizes. Such prizes are often welcome as means of defraying the expenses of the trip.

That the sport of trap shooting has a tremendous grip in the country is evident. Someone has said that there are 20,000 trap shooters in the United States. The number is increasing. These shooters fire millions of shots a year and provide employment for no small number of persons.

At any rate, the annual tournament at Vandalia remains the grandest shotgun carnival in the world, and does much to tell the world how clean and exciting this sport really is.



BY-PRODUCTS OF THE SPORT

Tons of lead shot fired at Vandalia are recovered from the soil and cast into bars like the ones shown above

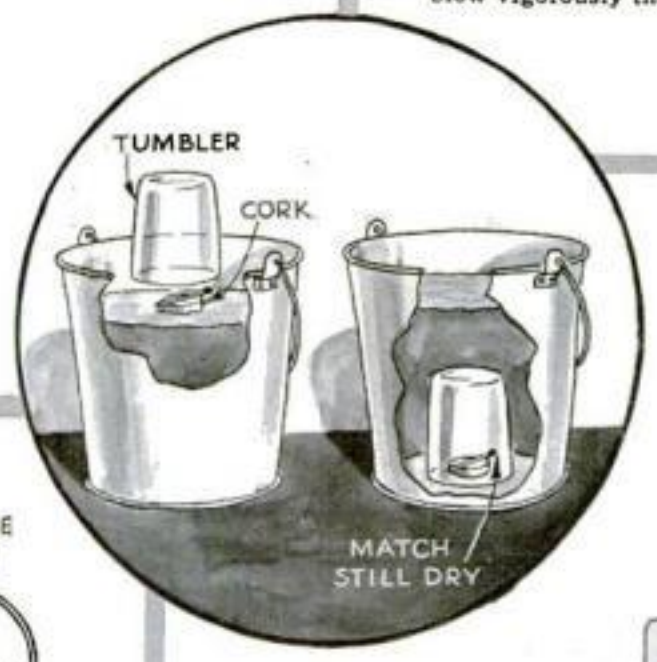
A few of the thousands of capped shells that accumulate at the field every year. The brass ends are salvaged as scrap metal, and save the association a tidy sum

Stunts for Home Scientists

BLOWING THROUGH A BOTTLE. Arrange a milk bottle and a lighted match as shown above. If you blow hard against the bottle, the match will go out just as though your breath had passed right through the bottle

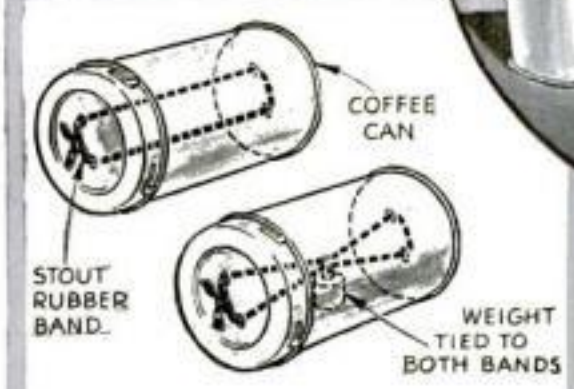
PUTTING EGG IN BOTTLE AND TAKING IT OUT AGAIN

To pass an egg into a bottle, first hard boil it and remove the shell. Light folded tissue paper and drop it into the bottle. Then quickly turn the bottle on its side and hold the egg against the bottle's mouth. It will be drawn into the bottle. To get the egg out, tip the bottle up against your lips as is illustrated. If you blow vigorously the egg will pop out



MATCH UNDER WATER REMAINS DRY

You can amaze your friends with the simple stunt illustrated at left. Float a flat cork in a pail of water and then attach to it an unlighted match. Cover the cork and match with a tumbler and lower tumbler to bottom of the pail. When you raise tumbler and remove match it will be dry

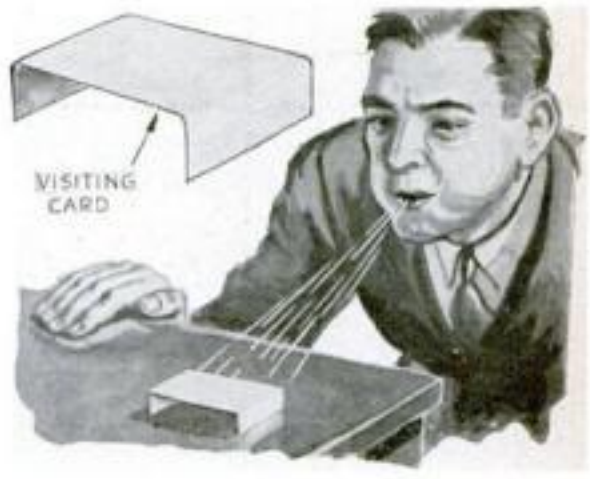


CAN ROLLS BACK TO YOU

Punch two holes near the center of the cover of a good-sized coffee can, and punch similar holes, about an inch apart, through the bottom. Pass a stout rubber band through the holes and tie its ends together. Tie a weight to the middle of the band inside the can. Then as can is rolled along the floor it will mystify spectators by returning to you

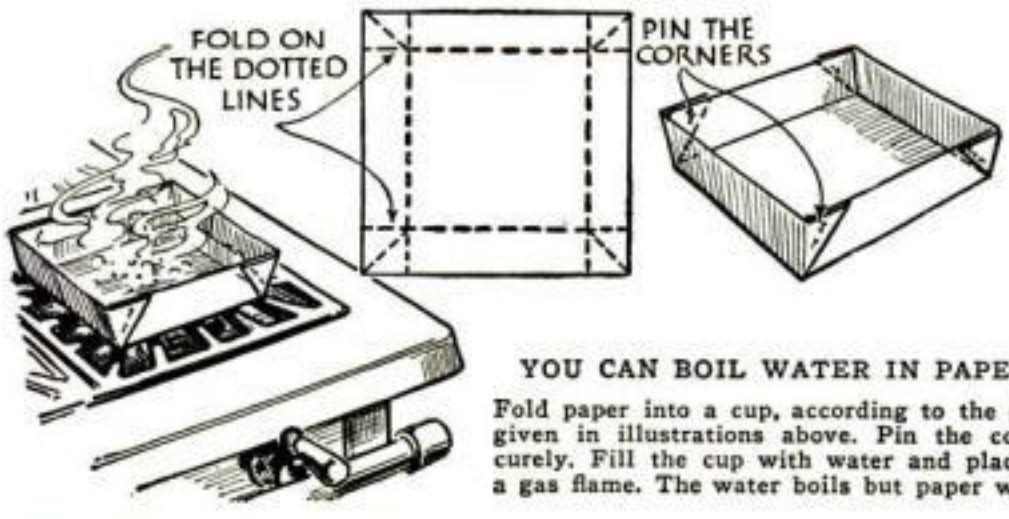
HOMEMADE BOOMERANG

Cut a cross, as shown, from cardboard with the arms one inch wide and one and a half inches long. Stand it up with the front edge slightly elevated. If you now flick one arm with a pencil, the boomerang will sail away but at last will return to your feet, exactly as does the Australian weapon. A boomerang, shaped like the real thing, is shown in the second drawing. It also will return when flipped into the air. Its arms are one inch wide



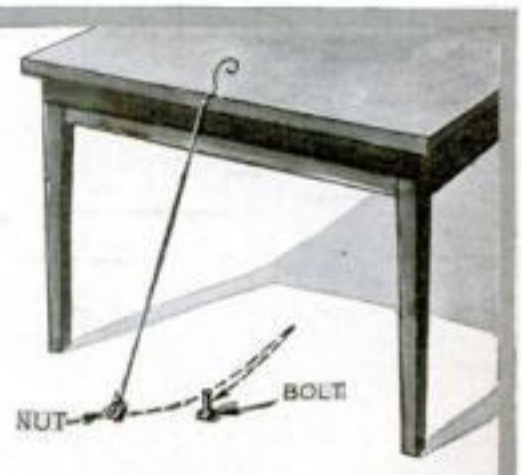
CAN'T BLOW OVER ONE CARD

Your friends will be baffled by this simple little experiment: Bend down a half-inch flap at each end of an ordinary visiting card and then stand it on a table. Ask your friends to try to blow it over. They will find it is impossible to do this



YOU CAN BOIL WATER IN PAPER CUP

Fold paper into a cup, according to the directions given in illustrations above. Pin the corners securely. Fill the cup with water and place it over a gas flame. The water boils but paper won't burn

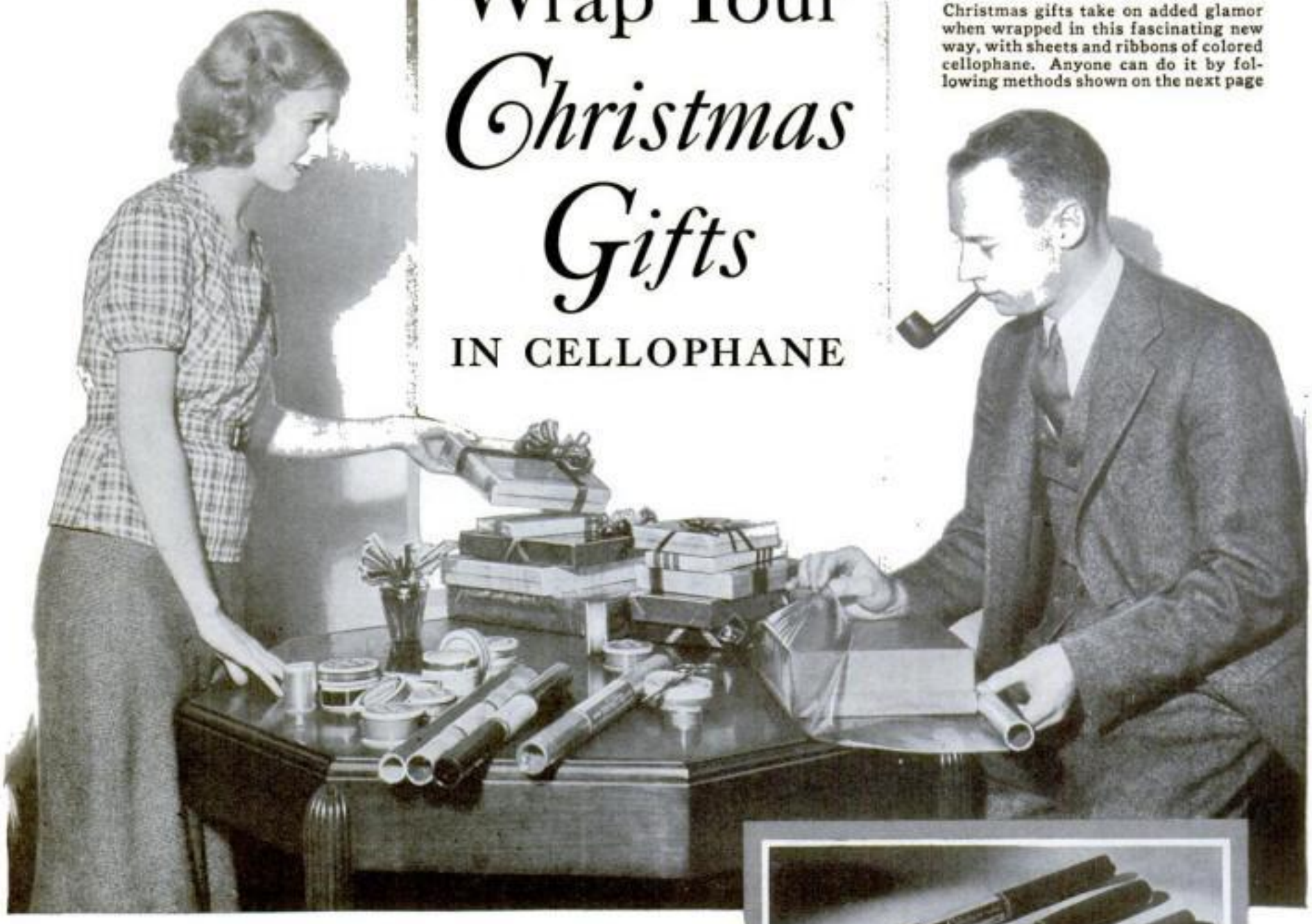


TRY SWINGING THIS PENDULUM

Tie a nut to the end of a thread which is attached to table edge, as shown. Stand a bolt on the floor and let the nut swing so it misses bolt one way but hits it on return

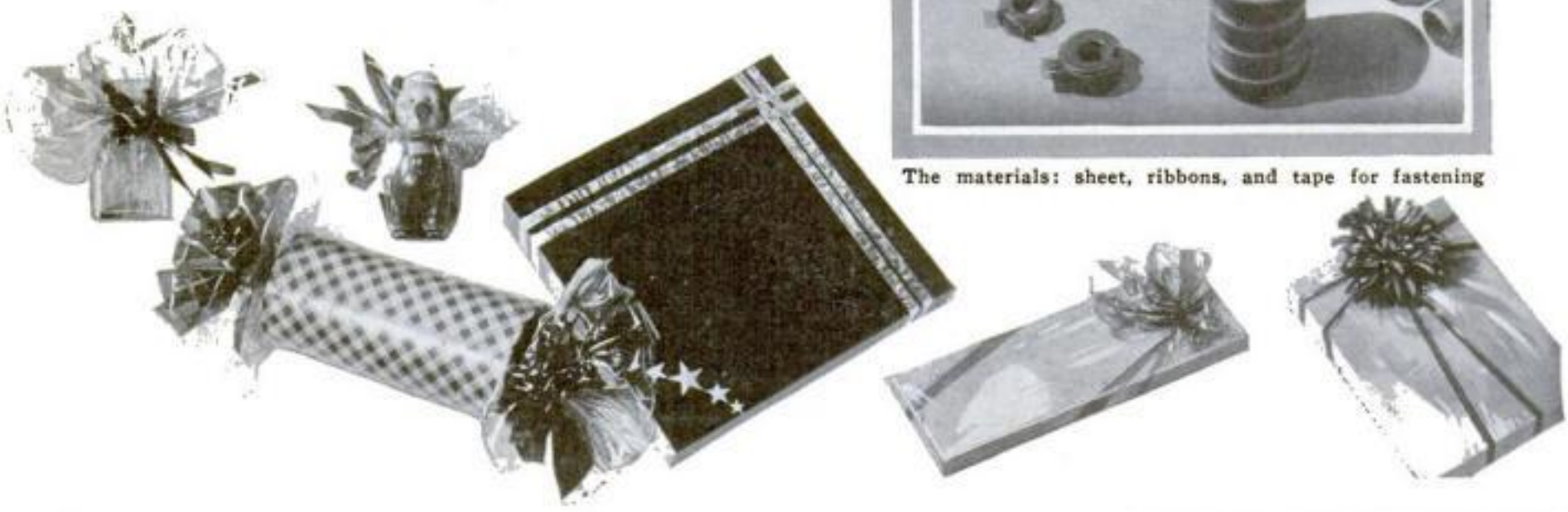
Wrap Your *Christmas Gifts* IN CELLOPHANE

Christmas gifts take on added glamor when wrapped in this fascinating new way, with sheets and ribbons of colored cellophane. Anyone can do it by following methods shown on the next page

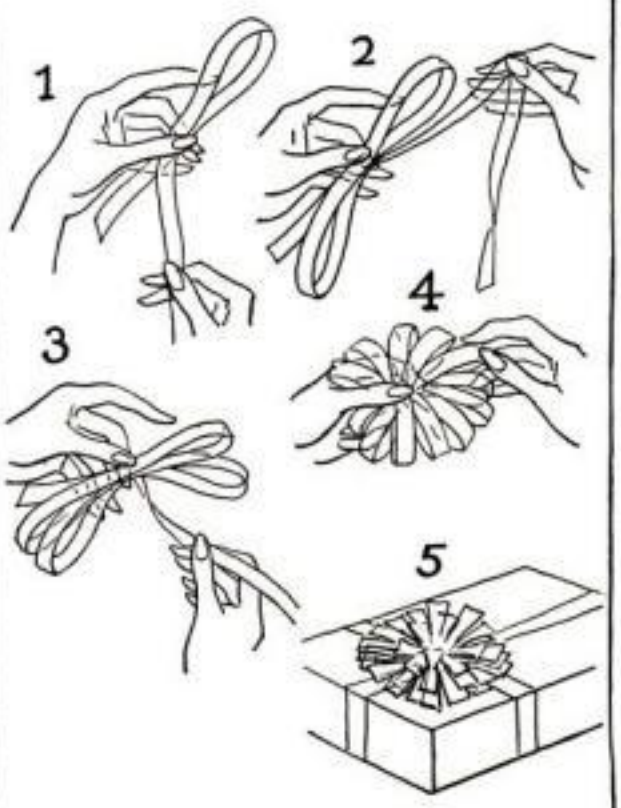


WOULD you like to try a fascinating new way to wrap your Christmas presents? Methods worked out by experts now enable any amateur to take advantage of one of the most modern and versatile of wrapping materials —cellophane. Available in sheets and ribbons and in all the colors of the rainbow, its sparkling luster provides an appropriate holiday trimming for modest and costly gifts alike. Gay wrappings and brilliant tyings for a pair of silk hose, a jar of tobacco, or bottle of fine perfume, are as effective in enchancing the attractiveness of the gifts as they are easy to make. Any stationery store can supply you with the materials, and illustrations and directions given on these pages show you how you can achieve decorative effects that rival the creations of professional designers. The methods illustrated here may be adapted, with variations, to other styles of packages, and elaborated upon to obtain additional decorative effects, according to the imagination and ingenuity of the user.

The materials: sheet, ribbons, and tape for fastening



How To Tie a Bow with Cellophane Ribbon

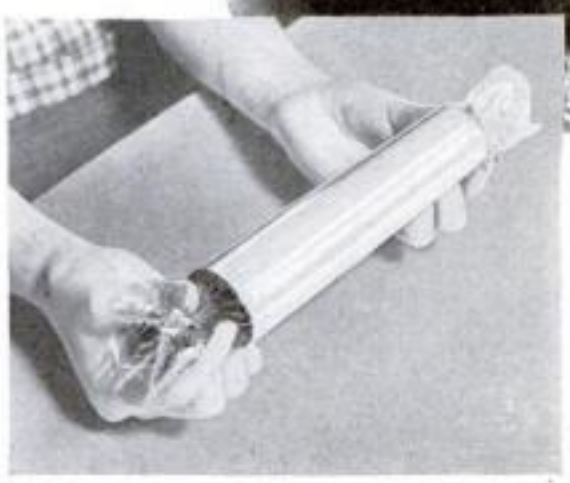


Form a loop (1), grasping it firmly with thumb and second finger of left hand. Make a second loop (2) and add two more, upper and lower (3). Cut the bow loose from the ribbon spool and spread it to a round shape (4). The design may be varied (5) by snipping off ends of loops after bow is attached

Neat Cylindrical Packages in Cellophane

1 Roll the gift (stockings, for example) in a piece of colored cellophane, using cardboard as a stiffener if necessary. Trim the cellophane, making sure that the edges project a few inches, and fasten with cellulose tape

2 Twist loose ends of cellophane close to the package, and work them with the fingers to the shape shown. It is important to allow a margin wide enough for effective work



3 The two ends are tied with cellophane ribbon and small bows are attached as shown above, making an attractive parcel

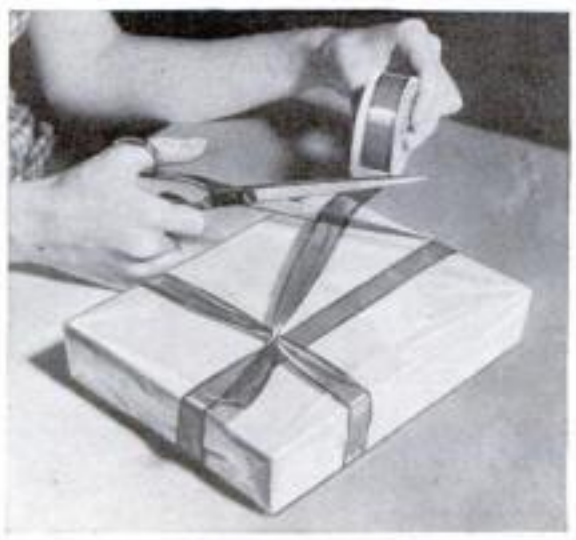
Oblong Boxes Are Easily Wrapped by This Method

1 Unroll a length of cellophane and lay the box upside down upon it, so that the top side will show no joints. Measure off enough cellophane to encircle the package, plus one inch for overlap, holding the roll as shown

2 Cut the measured length of cellophane from the roll. Stick the edges together with short patches of Scotch cellulose tape to hold the wrapping in place during later operations. Being transparent, the tape is almost invisible

3 Fold in the sides as with ordinary paper. Seal all joints with additional patches of Scotch tape. Cellophane should always be wrapped loosely to allow for shrinkage. Do not pull it too tight around corners of the package

4 Tie the package with cellophane ribbon. A bow is to be added at the knot; meanwhile, a single twist of the ribbon will hold it in place. The knot may be tied in the middle or at the side of the package, as your artistic sense may direct you

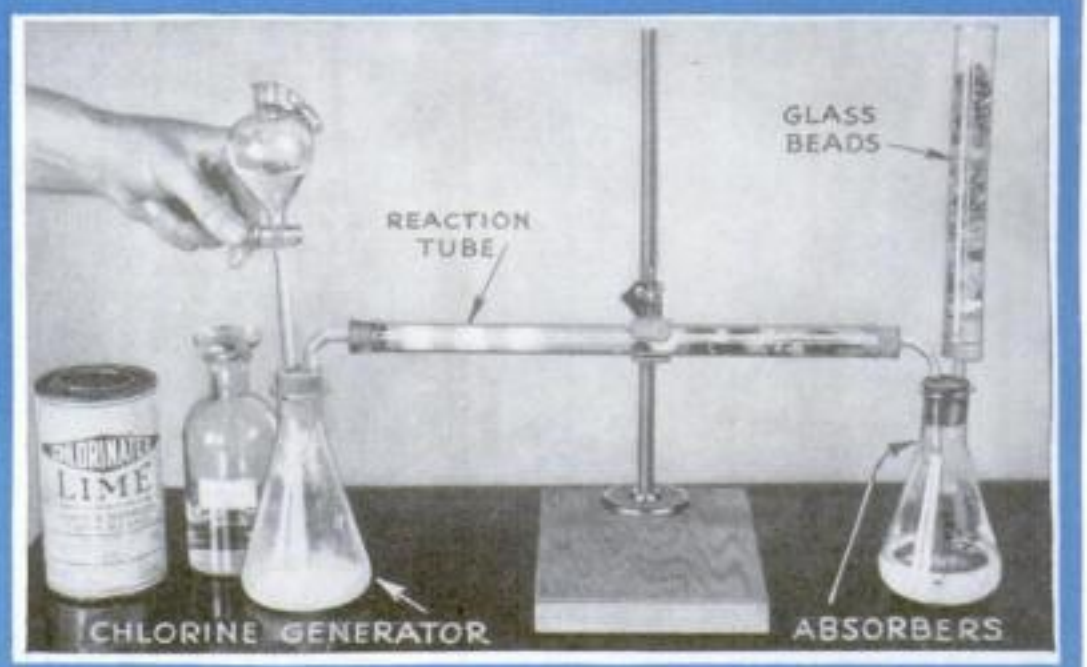


5 The bow, made separately as shown at the upper left of this page, is placed in position over the knot. With the loose ends of the ribbon on the package, tie the bow in place using a double knot. Smooth out the loops and cut off ends that are long

Analyzing Everyday

IN THE HOME

IRON. The presence of iron is easily determined. Under certain conditions, the addition of one or two drops of a soluble sulphocyanate chemical will produce a red color



CHLORINE GAS. Generated in the flask at the left, chlorine gas displaces bromine from a compound and the bromine, in turn, will then displace iodine

TO MAKE use of his knowledge of chemistry, the home experimenter need only turn to his medicine cabinet and kitchen shelves. Hundreds of everyday substances offer chemical mysteries that can be solved with test tube and burner in even the simplest of home laboratories.

As a starting point, consider ordinary laundry bluing, sold both as a liquid and as a solid. Usually, liquid bluing is merely a solution of Prussian blue (iron ferrocyanide) dissolved in some organic acid such as oxalic acid. However, it is a simple matter to verify its composition.

First, dilute about a half teaspoonful of the bluing with several times its bulk of water. The professional chemist would use distilled water to avoid impurities, but for the home chemist's purpose ordinary tap water will serve. To this solution add some sodium hydroxide or potassium hydroxide, pouring the liquid drop by drop until the bluing solution becomes almost colorless or water-white. This change in color will indicate that the mixture is in the proper form for chemical analysis.

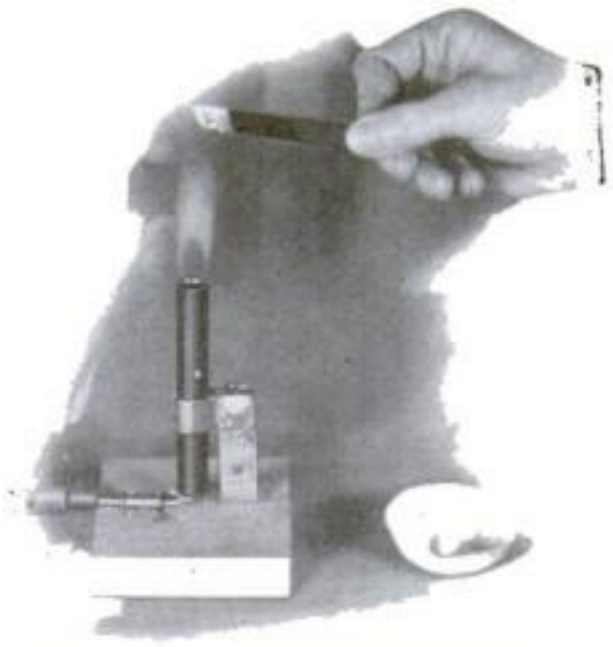
Watch the solution carefully. Soon a brown precipitate will be formed in increasing quantities. When this occurs, complete the reaction between the hydroxide and the bluing by boiling the mixture for a minute or two.

The next step in the analysis is to filter off the brown precipitate and wash it thoroughly by pouring or squirting hot water into the filter-paper funnel. Allow these washings to mix with the original filtrate which passed through the paper and save the solution for further tests.

Pour a dilute solution of sulphuric, nitric, or hydrochloric acid over the precipitate on the filter paper. This will dissolve the solid and the liquid passing through will contain the iron, if any was present in the original bluing. As a final test, add one or two drops of sodium (or potassium) sulphocyanide. If a red color forms, iron is indicated and it is safe to assume that it came originally from the Prussian blue.

To test for the oxalic acid, add a drop or two of clear lime water, or calcium chloride solution, to the filtrate which was preserved. If a white precipitate forms, it is in all probability calcium oxalate, indicating that oxalic acid was present initially. This can be confirmed by adding several drops of hydrochloric or nitric acid to the liquid. If the white precipitate is dissolved, calcium oxalate undoubtedly was present.

Dry bluing, sold in the form of convenient squares or balls, contains neither Prussian blue nor oxalic acid. Instead, it is made by heating a mixture of clay, sodium sulphate, sodium carbonate, sulphur, and sodium sulphide. The presence of the sulphide is easily detected. Simply add several drops of acid to small bits of the solid. Immediately an effervescence or bubbling will take place and hydrogen sulphide gas will be liberated. The identity of the gas can be recognized not only by its characteristic odor but also by the fact that it will turn strips of paper, moistened with a lead acetate solution, a deep brown or black. Incidentally, this action of solid bluing provides a simple method of making small quantities of the gas for consumption in your home laboratory.



BORAX. A strip of mica can be used in making borax bead tests. Ordinarily, platinum wire is used for this, or sometimes iron wire

Ordinary table salt forms another interesting subject for a simple chemical analysis. It, too, is sold in two forms, plain and iodized, the latter containing a soluble iodide. Here again, the home chemist can determine the difference chemically. The test, a novel experiment in itself, consists of freeing the iodine, if it is present, and identifying it by means of some telltale reaction.

To a small quantity of the salt dissolved in water to make a solution, add several drops of starch solution prepared by dissolving ordinary corn starch in water. Then add several drops of dilute chlorine water. If a dark blue color ap-

Substances

LABORATORY

By
RAYMOND B. WAILES

pears, iodine is present. The chlorine water for this test can be made by adding dilute acid to bleaching powder in a flask and bubbling the chlorine gas given off through a bottle of ordinary tap water. (P. S. M., Oct. '33, p. 51).

If desired, the test for iodine can be carried out in another manner. Instead of adding starch solution, pour a small amount of carbon tetrachloride into the salt water and then add the chlorine water as before. If iodine is present, it will be liberated by the chlorine and will dissolve in the carbon tetrachloride, coloring it violet.

This ability of chlorine to free iodine from its compounds, illustrates an important quality of a specific group of closely related chemical elements known as the *halogens*. These elements, the best known of which are chlorine, bromine, and iodine, exhibit a marked tendency toward displacement. Chlorine, for instance, will free or displace both bromine and iodine from their compounds, while bromine will displace iodine but not chlorine. Iodine, on the other hand, exhibits no ability to displace either of its sister elements.

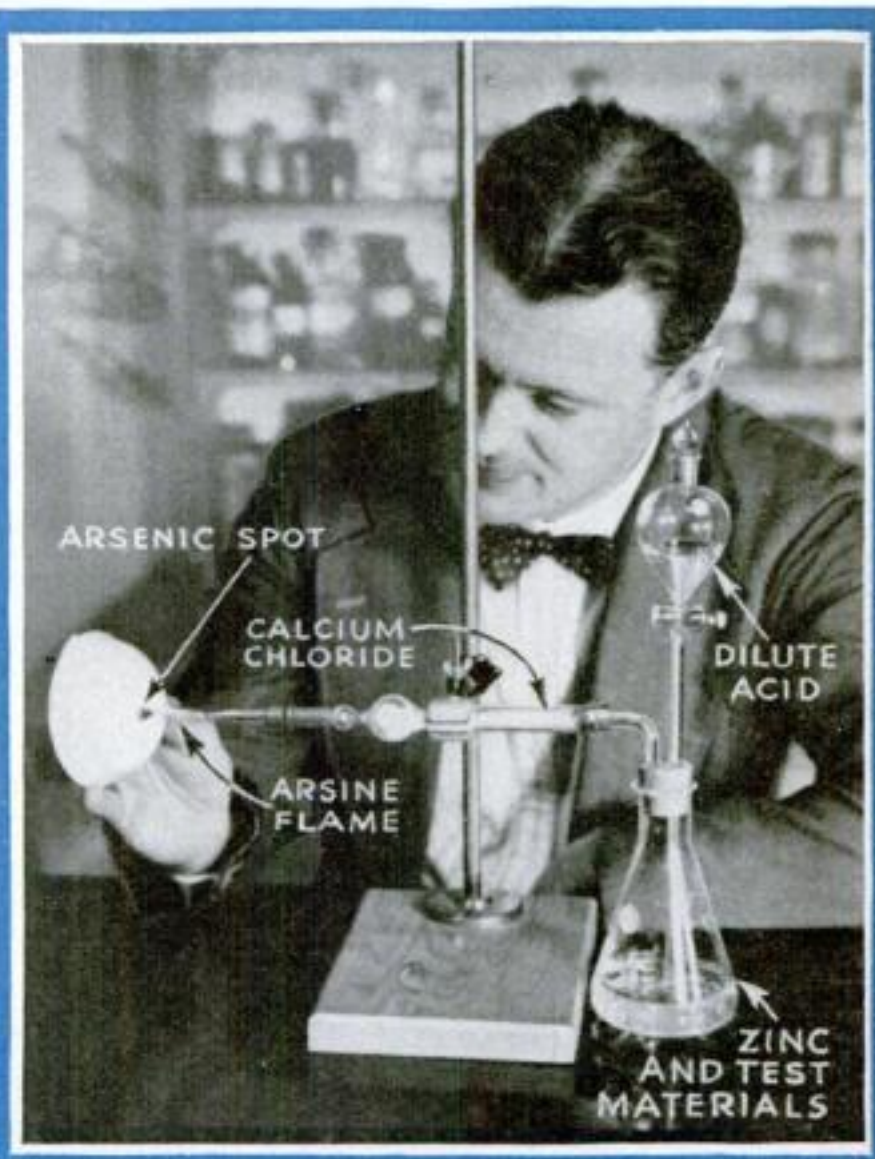
By using a novel, but easily assembled, piece of apparatus, the amateur chemist can illustrate this action vividly. As shown in the photograph, it consists principally of two small flasks; two large-diameter glass tubes, a long one and a short one; a supply or separatory funnel; some ordinary glass tubing, and a foot or so of rubber tube.

The long, large-diameter tube should contain at one end two plugs of loosely packed cotton between which is placed a half inch of solid sodium (or potassium) bromide. Spaced an inch or so from this set of plugs should be a second set enclosing a half inch of sodium (or potassium) iodide. Finally, this is followed by a strip of test paper made by immersing white paper in a solution of starch.

A chlorine gas generator consisting of a stoppered flask having a supply funnel and containing bleaching powder is attached to the end of the tube nearest the bromide compound. The other end of the tube should lead to an absorbing flask containing a caustic solution such as lye. To make sure that none of the poisonous gases escape into the air, a supplementary absorber, consisting of an upright tube containing small glass beads over which the caustic solution has been poured, should be attached to the outlet of the absorbing flask. The moist beads present a large surface to the gases passing through the system and allow complete absorption.

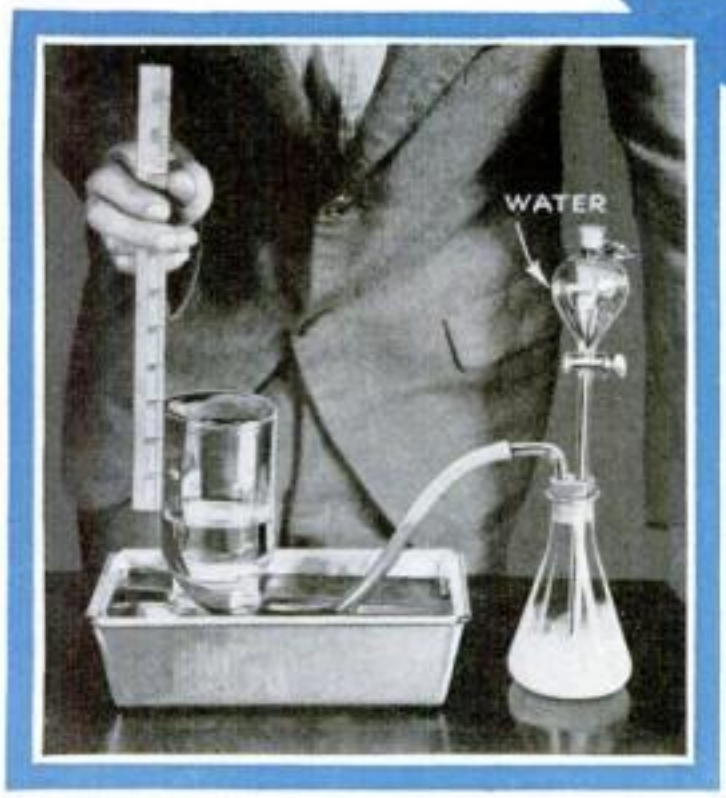
To start the reaction, place some dilute acid in the delivery funnel and allow it to drip on the bleaching powder contained in the generator. This will liberate chlorine gas, which will pass on to the reaction tube where it will come in contact first with the bromide compound. Passing over the chemical, it will release the bromine which can be recognized by its red vapor as it passes into the empty center portion of the tube. Being pushed along by the chlorine entering from the generator, the free bromine will come in contact with the iodine compound stored at the other end of the tube. As it does, a purple vapor will be noticed. This is the iodine freed from the compound by the bromine. That the gas is iodine will be shown by the fact that it will turn the starch paper a deep blue.

Laxative medicines offer the home chemist another field for analysis and interesting experimentation. In most of the candy and gum laxatives, the familiar chemical phenolphthalein is the active ingredient. The test is to identify phenolphthalein a simple one. First make the laxative into a solution by adding it to water and heating. Then filter it. If the filtrate takes on a definite reddish-purple color when a caustic solution is added, phenolphthalein is indicated. Add a strong acid to the *(Continued on page 126)*

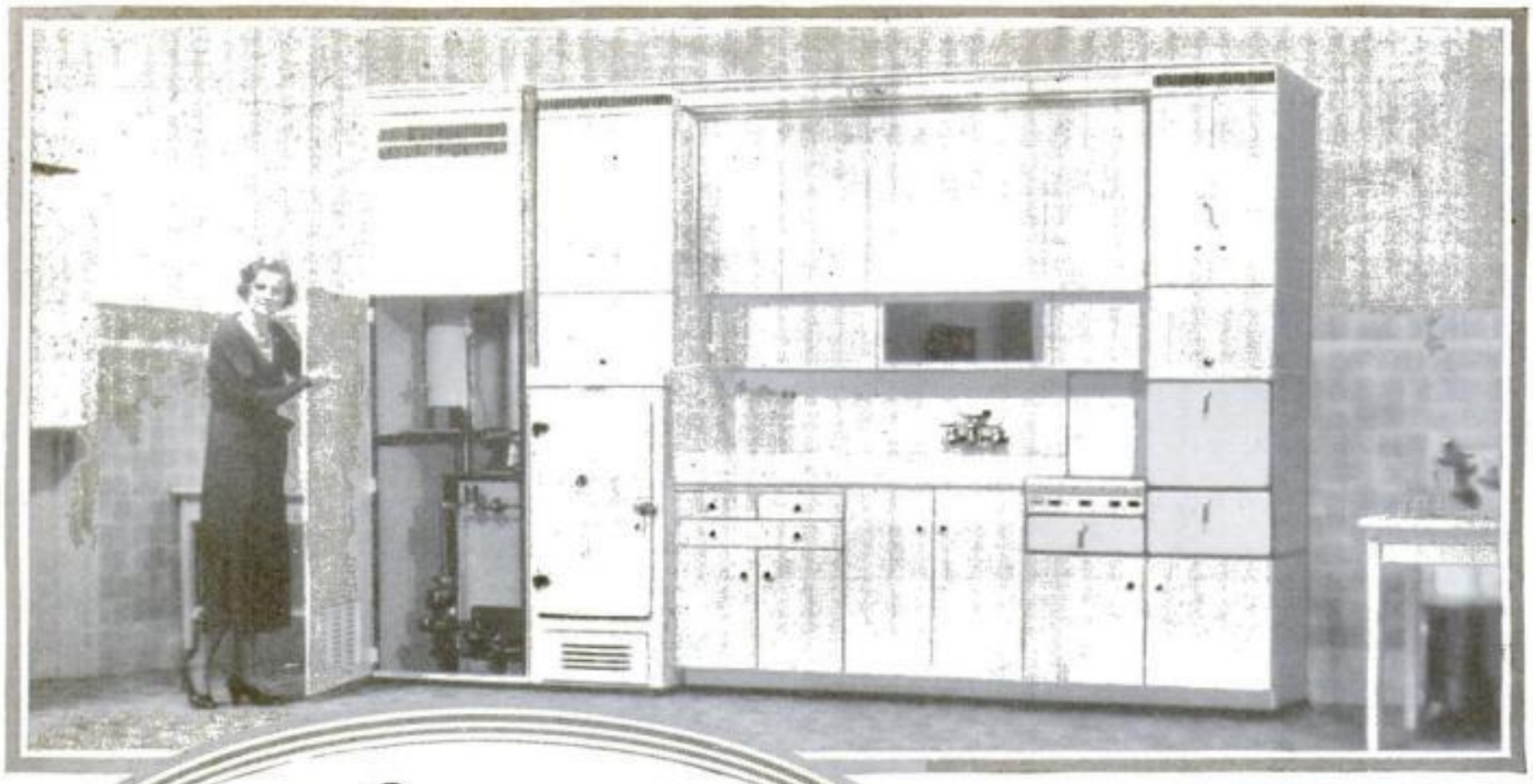


ARSENIC. Marsh's test for arsenic consists of generating hydrogen gas in the presence of the substance being tested. If arsenic is present, arsine gas will be formed and can be identified as shown

PNEUMATIC TROUGH. To measure gas liberated in tests like the one shown at the left, a simple pneumatic trough can be arranged easily as shown above



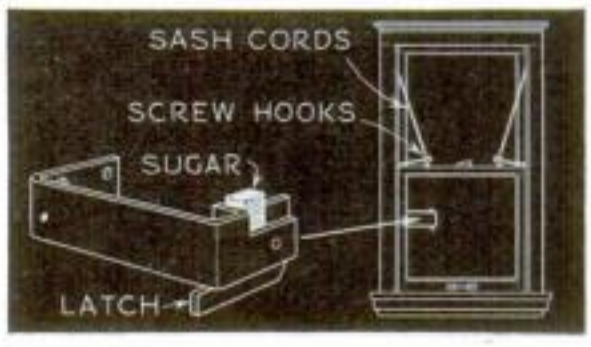
BAKING POWDER. It is easy to compare the volumes of gas liberated by equal amounts of various baking powders. The carbon dioxide gas displaces the water from the bottle, where its volume is measured



Latest INVENTIONS FOR THE Household

HEATER IN KITCHEN CABINET. Contained within the cabinet shown above is the heating plant for the entire house, thus doing away with the necessity for a basement. Its gas-fired boiler is capable of heating a seven-room house. It also contains range, refrigerator, and a big sink

DAYLIGHT BULB. You can have a daylight lamp simply by slipping over the bulb the cap shown above. It filters out yellow rays giving an illumination that is easy on the eyes. At upper left, a vegetable cooker that is said to cook food without loss of flavor. Circulated steam does the work

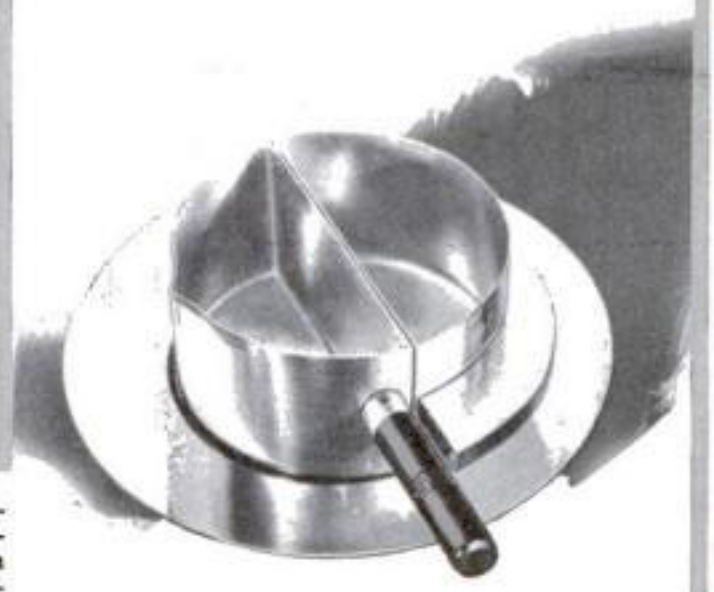


SCRUBBER AND SCRAPER. The scrubbing cloth, left, comes with a convenient scraper permanently attached to one corner so it is ready for instant use. The cloth is woven of strong mesh and the scraper is of durable metal that will not rust

RAIN CLOSES WINDOW. The automatic device, illustrated above in photograph and drawing, will close a window of its own accord when rain starts. It consists of a trigger holding open the window and a lump of sugar. As rain melts the sugar, the trigger is released and down comes the window, the sash falling of its own weight

AUTOMATIC GAS PLATE. Provided with a pilot light and a valve, this gas burner lights itself when a pot is placed over it and goes out when the pot is removed. A movable plunger, actuated by weight of the pan, operates the device

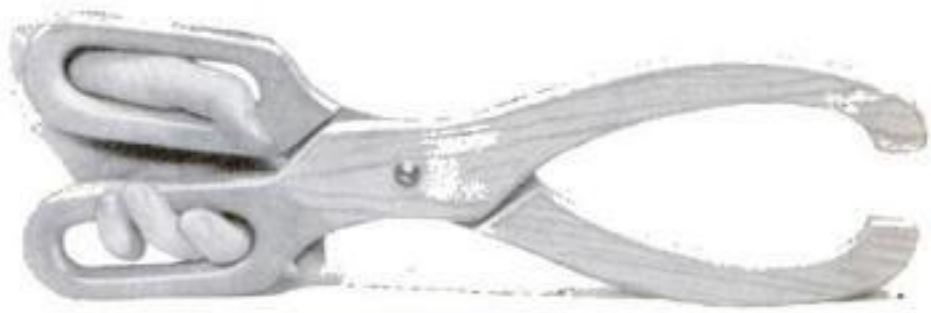
SUGAR AND CREAM SET. The double dish, illustrated below, is designed to hold both the sugar and cream. A nose on the cream section makes it possible to pour the cream without spilling it



STOOL AND LADDER. A useful accessory for the kitchen is the combination stool and stepladder shown above. As the top is lifted, the lower step falls automatically into place. Lowering the top folds up the step. At left, the device is shown with the step closed to change it into a stool

SEALING JARS. A transparent material is dipped in water and then bound around the top of a preserve jar. As the material dries, it contracts, thus forming what is said to be a perfectly airtight seal. No sealing wax is necessary with it

TUB AND WASHSTAND COMBINED. The greatest possible use of limited space is made with the unit shown below. It consists of a bathtub and washstand combined. The tub is placed in a recess in the base of the washstand, along with medicine chest



CLOTHES LIFTER. Made of maple and insulated against heat, this clothes lifter makes it unnecessary to burn the fingers picking clothes out of hot water. It can also be used to feed the clothes into the wringer, thus guarding against possible injury

WHIRLS WATER TO MAKE COFFEE. At right is illustrated a device that makes coffee by a new method. It contains an electric motor that whirls hot water through ground coffee at high speed. At the end of three to four minutes a pre-set automatic timer stops the motor and coffee is ready to serve

All you need to hunt long-delay echoes is a short-wave set

Hunting Echoes, New Radio Sport

FANS CAN HELP SOLVE THE LATEST MYSTERY

By GEORGE H. WALTZ, JR.

THOUSANDS of short-wave fans are now hunting radio's newest mystery—delayed echoes. Working with noted scientists, they are searching for the cause of weird signal ghosts that often reach a receiver many seconds after the original wave.

These echoes were first reported in 1927 by J. Hals, a scientist living in Norway. Listening to a code message from the Dutch station PCJJ transmitted on a frequency of 9,600 kilocycles, he noticed that many of the signals were followed by a faint echo or repetition. Trailing the originals by more than three seconds, these echoes differed from the common type caused by radio waves traveling around the globe (25,000 miles), in one seventh of a second. Figured on the basis of elapsed time, they had traveled more than 500,000 miles. Later, verifications were obtained, some showing echoes that lagged a full half minute.

At first, it was thought that the long-delay echo was caused by a portion of the radio wave reflected from the moon. But this theory was soon discarded in favor of another which laid the cause to a concave reflecting surface located hundreds of thousands of miles from the earth's equator and formed by the streams of electrons that are thought responsible for our northern lights.

To obtain more information about these mystifying echoes, an international search has been organized. Scientists have called on every short-wave fan to coöperate.

Two powerful European short-wave stations, GSB at Daventry, England, and HBL, the League of Nations Station at Geneva, Switzerland, are transmitting a series of test programs arranged especially for the observation of long-delay echoes. The signals from GSB are transmitted on a modulated frequency of 9,510 kilocycles (approximately 31.5 meters) every Sunday, Tuesday, and Thursday, from 3:25 to 3:55 A. M., Eastern Standard Time, while the HBL signals are sent out on an unmodulated frequency of 6,675 kilocycles (approximately 45 meters) each Sunday, Wednesday, and Friday from 6 to 6:30 A. M., Eastern Standard Time.

Each transmission begins with a five-minute tuning period, station GSB using phonograph music and HBL repeating its call letters in Morse code. This is followed by the test, which consists of the letters of the alphabet, sent in order and spaced at time intervals of one minute.

To join in this search, all that you need is a high-frequency receiver, a good watch with a second hand, a pencil, and some paper. The station you follow in your tests will depend on the type of receiver you own. If it is of the short-wave broadcast variety, it will be necessary to confine your efforts to the modulated signals from GSB since the unmodulated continuous waves transmitted by HBL are receivable only by a set having an oscillating circuit.

Once you have adjusted your receiver during the five-minute tuning period, stand by for the letter A. Record the time (to the nearest second) at which each succeeding letter is received and listen for echoes during the one-minute intervals between. If any echo is noticed, no matter how faint, note the elapsed time between the original signal and the repetition, the relative strengths of the original and echo, and any other information you believe is important.

Send your data to Dr. J. H. Dellinger, chief of the radio division of the Bureau of Standards in Washington, D. C., who is acting as the clearing house for reports in the United States. State clearly the identifying letter of the signal observed, the time to the nearest second at which the direct signal was received, the time to the nearest second at which the echo was heard, and an estimate of the relative strengths of each.

Above, a station of the National Bureau of Standards for the study of long-delay echoes. It records the echoes automatically

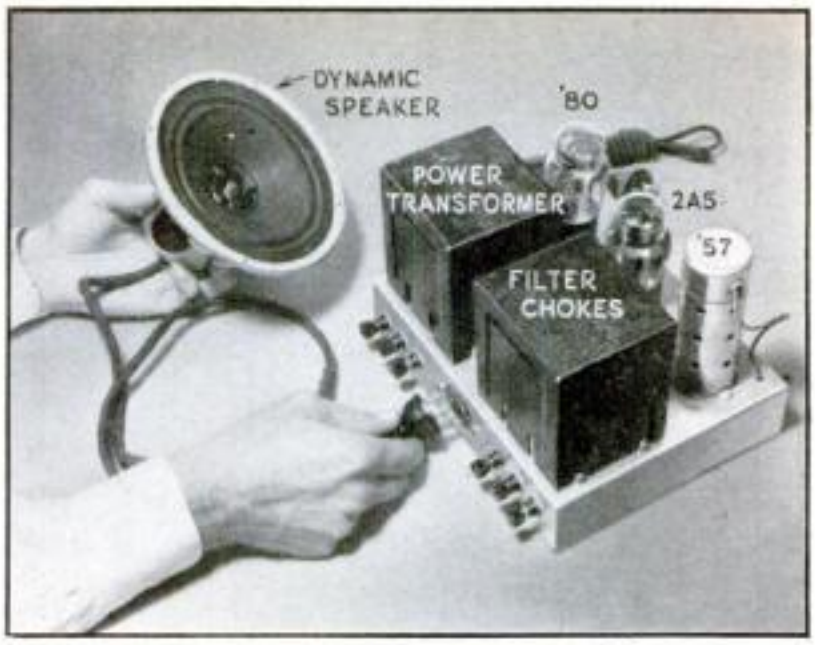
Right, another Bureau of Standards station near Washington. This one is not automatic, but requires the presence of an operator to record the movements of the echoes

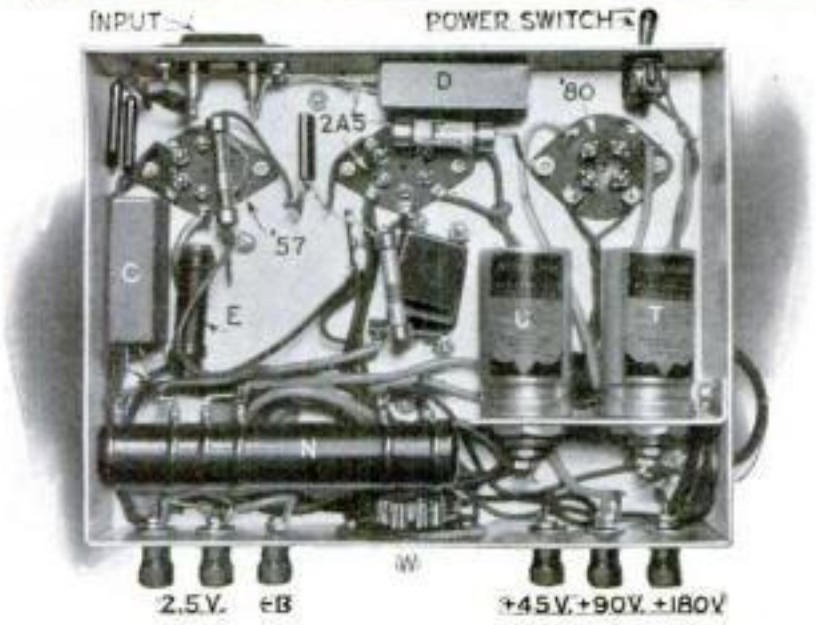
EASILY BUILT

AMPLIFIER

Has Many Uses

By WALTER J. BRONSON





At top, view showing arrangement of parts on the top of the chassis. Note connections to speaker are made through five-prong plug. Above, underside of the chassis

What is Needed for This Amplifier

A and B.—Fixed condensers, mica, .004 mfd.
C and D.—Fixed condensers, 25 mfd., 25 volt.
E.—Fixed resistor, 800 ohms.
F.—Fixed resistor, 500 ohms.
G.—Fixed resistor, 100,000 ohms, 1 watt.
H.—Fixed resistor, 250,000 ohms, 1 watt.
J.—Fixed condensor, .01 mfd.
K.—Output transformer (mounted on speaker.)
L.—Filter choke, 2500 ohms, 30 henry.
M.—Filter choke, 400 ohms, 12 henry.
N.—Voltage divider, 18,000 ohms.
P.—Power transformer; two 2½-volt, one 5-volt, and one 180-volt winding.
Q and R.—Fixed condensers, non-inductive, .1 mfd.
S.—Toggle switch, 110-volt type.
T and U.—Electrolytic condensers, 4 mfd., 500 volt.
V.—Electrolytic condenser, 4 mfd. 600 volt.
W.—Speaker plug and socket.
Y.—Dynamic speaker, preferably 2,500-ohm field with output transformer (K) mounted on frame.

Miscellaneous: One '57 tube, one 2A5 tube, one '80 tube, a 2 by 7 by 9 in., chassis, solder, connecting wire, input jack, binding posts, etc.

FEW pieces of radio equipment prove more valuable to the amateur set builder than a good auxiliary power amplifier. Such a unit is illustrated on this page. It has excellent quality and high fidelity, but its design makes it both inexpensive and easy to assemble.

Although little larger than a small receiver, being mounted on a 2- by 7- by 9-inch aluminum chassis and using only three tubes, this compact unit has a variety of uses. Besides serving as a two-stage amplifier for a phonograph pick-up, a receiver, or a small public address system, it also provides a hum-free power supply capable of furnishing 45, 90, and 180 volts B current and 2½ volts for a heater circuit.

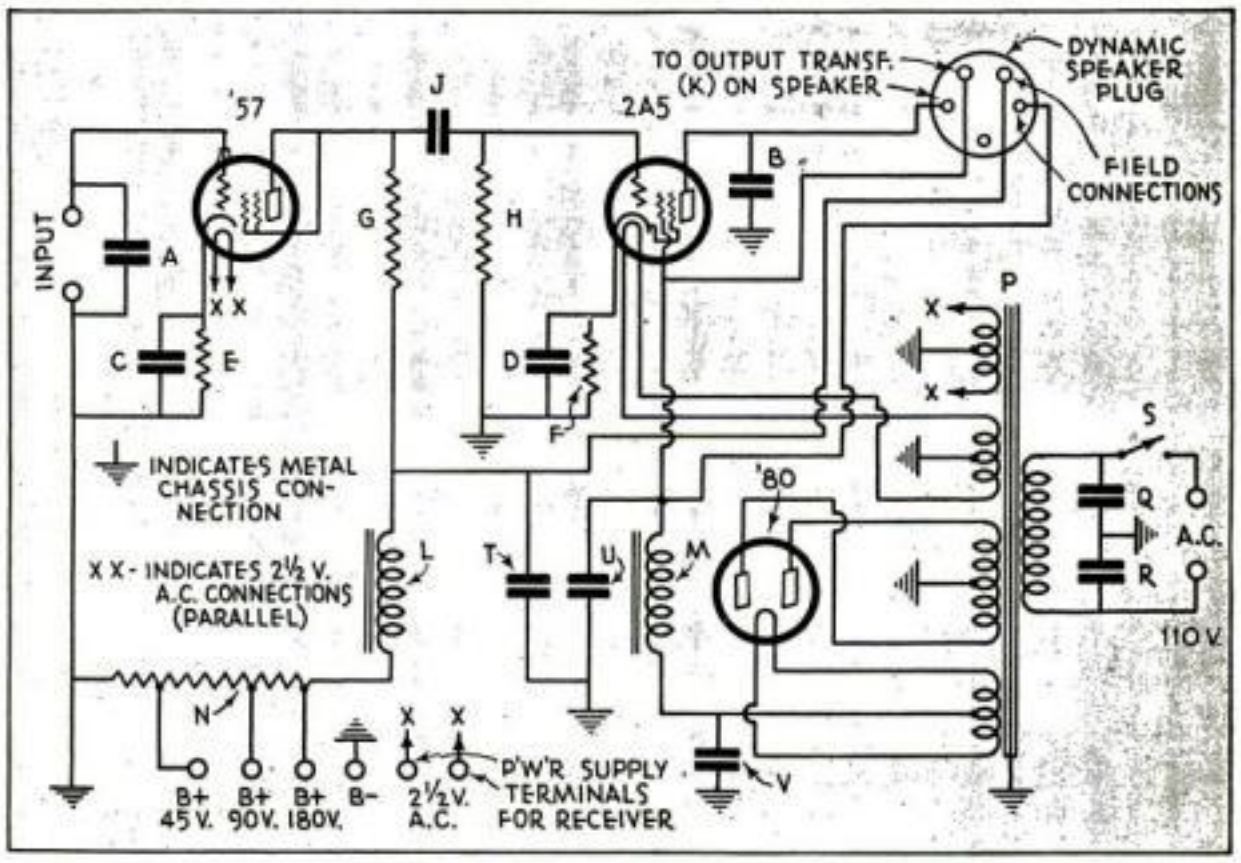
The assortment of simple parts required are listed in the box on this page. Minus the tubes and the speaker, they should not cost you more than $8 complete.

Looking over the wiring diagram, you will find that the circuit is of the normal class A amplifier variety, making use of a type '57 in the initial stage, a 2A5 in the final stage, and a type '80 as the rectifier. In connecting the socket of the '57 tube, the screen, suppressor grid, and plate are tied together, making them function more or less as a single element and transforming the tube into a triode (three-element tube). Although this causes some loss in signal strength in the input, any decrease in volume is more than overbalanced by the improvement in tone quality obtained.

Shunted across the input grid to the ground, is a .004-mfd. mica condenser. This is an optional arrangement, but the writer has found that it tends to improve the tone quality. Try the circuit both with and without this shorting condenser and retain the arrangement that gives the best all-around results.

The two .1-mfd. condensers connected into the power input (A.C.) at the power cord also are important items in the circuit. Although not so important when the unit is used as a straight amplifier, they do improve conditions when the power supply is used in connection with a short-wave tuner.

How the amplifier is used will depend on the unit to be connected to its input. With a small receiver, a grid leak (1 meg.) should be wired across the amplifier input and a condenser (.1 mfd.) should be placed in the wire leading to the grid of the '57 tube. On some receivers, the grid leak can be omitted. A high-impedance pick-up can be wired directly, while a microphone must be used with the usual microphone transformer and battery circuit.

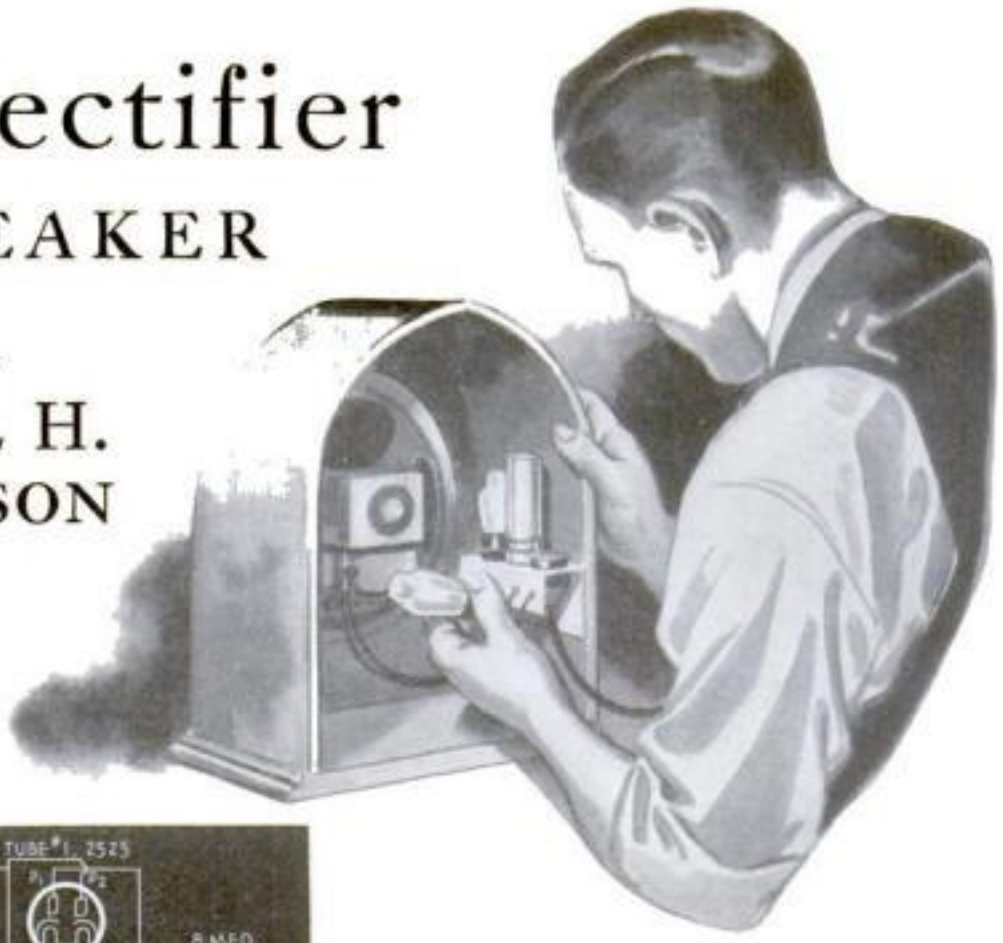


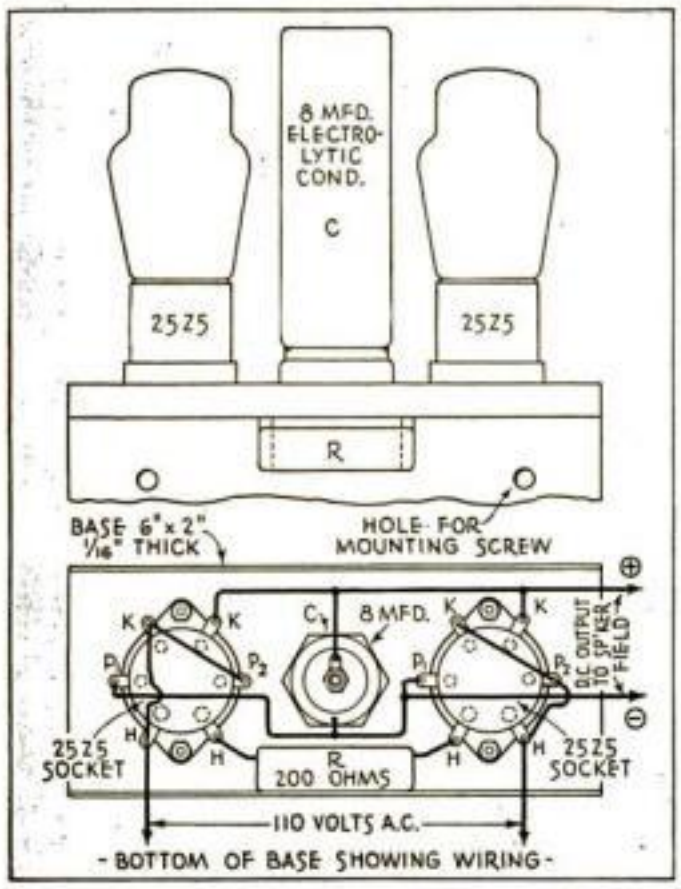
Circuit drawing for the amplifier. Compare letters with parts list as given in the box above

Low-Cost Rectifier

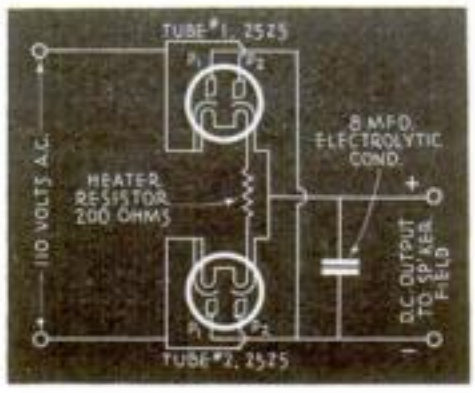
FOR EXTRA SPEAKER

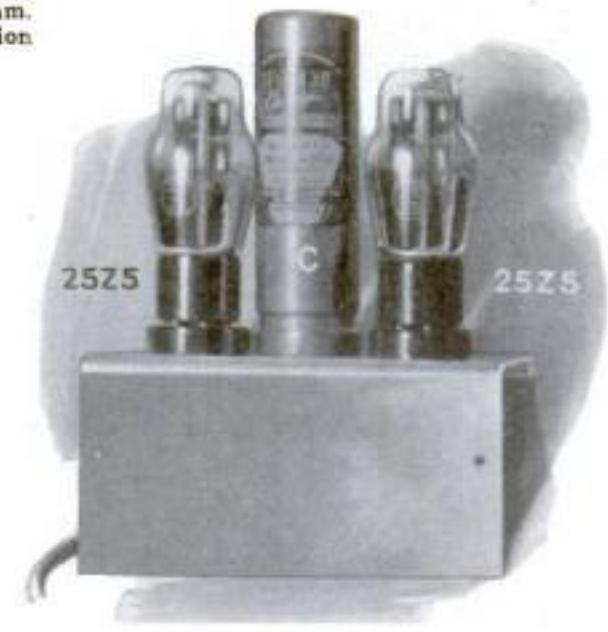
By PAUL H. NELSON





Above, wiring diagram and general layout of the small chassis. Right, schematic wiring diagram. Note resemblance to a bridge circuit connection





Front view of the power supply, showing the arrangement of the two tubes and condenser

IF LACK of the proper rectifier has prevented you from making good use of a spare dynamic speaker, you can solve the problem by building the inexpensive power unit illustrated. It can be used as a field supply for a portable public-address speaker or as a power circuit for a remote speaker connected to your regular receiver in the manner recently described in detail (P. S. M., Feb. '34, p. 54).

In districts where alternating current is supplied, a rectifier of some kind must be used to supply the electro-magnetic field of a dynamic speaker with direct current. Unlike most units, this rectifier uses two type-25Z5 tubes connected in what is called a "bridge circuit." This arrangement, giving full-wave rectification at full line voltage, eliminates the necessity of using a power transformer.

As shown in the photographs, the parts are arranged on a 2- by 6-in. aluminum base resembling a small U-shaped chassis. The rear flange of the base should be made deeper than the front flange to provide space for the mounting screws used to fasten the power unit to the speaker baffle board or other convenient surface.

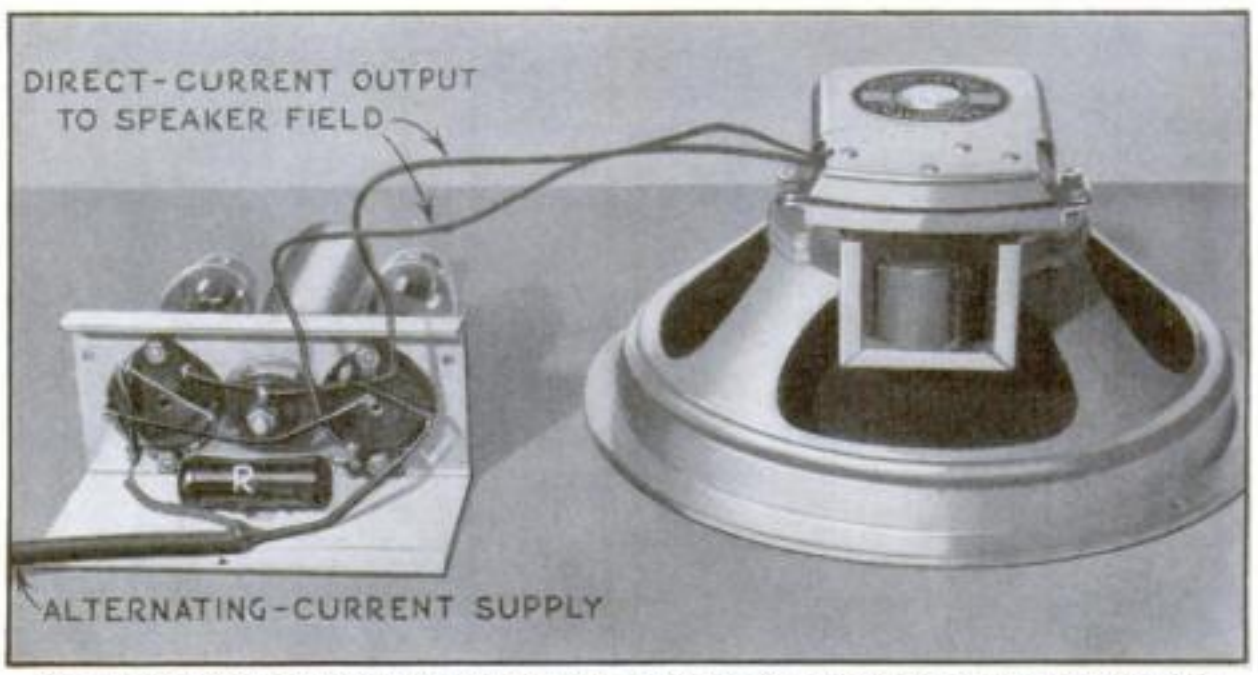
Mounted on the top face of the base are the two six-prong wafer sockets and the single eight-microfarad electrolytic condenser (C) that serves as the filter. Under the chassis is the 200-ohm, twenty-watt heater resistor (R) held in place by its soldered connections to one heater prong of each tube.

No difficulty should be encountered in wiring the unit once the various terminals of the six-prong sockets have been located. The combined heaters of the two tubes are connected in series to the alternating current supply and the 200-ohm heater resistor. This resistor reduces the 110-volts supplied to the total of fifty volts required for the heaters (twenty-five volts for each tube). The remainder of the wiring, except for the connections to the terminals of the electrolytic condenser, centers around the sockets.

In connecting the electrolytic condenser, remember that the center terminal is positive while the outside can is negative. The negative connection can be made directly to the case or it can be made to the metal chassis through one of the socket-mounting bolts.

The power connections should be made through a regular insulated cord and plug to the alternating-current supply, while the rectified direct-current output can be fed to the speaker through two wires leading to the field winding. The voice coil of the speaker should, of course, be wired to the output of the receiver or public-address amplifier in the usual way.

Connected to the 1,500-ohm field of a speaker, the unit will supply more than seven watts of almost rippleless power. If desired, the speaker can be fitted with a hum-neutralizing coil to dampen any slight ripple that may remain.



This photograph shows how the power supply is connected to the field winding on a dynamic speaker. The power supply cable should be fitted with a plug for connection with a floor plate

Question: What is the height of the greatest ocean waves? G. L. P., New Haven, Conn.

Here's *the* Answer

A.—THE HIGHEST ocean waves so far reported by reliable observers measured seventy feet from trough to crest.

Land-Locked Shark

Q.—ARE sharks ever found in fresh water? —F. J. S., Detroit, Mich.

A.—NORMALLY, no. However, sharks as well as other sea fish have been found in Lake Nicaragua in Central America. It is thought that this body of water, once an inlet of the Caribbean Sea, was closed off by a volcanic disturbance to form a lake. The sea fish present at the time became land-locked and adapted themselves to the changing conditions as the rivers flowing into the lake slowly converted it into a body of fresh water.

Cincinnati or Porkopolis?

Q.—IS IT true that Cincinnati was once known as Porkopolis?—W. E. R., Cincinnati, O.

A.—YES, in 1840. It gained this name by being the best known pork-packing center in the world.

They Dawdle Along

Q.—HOW fast do plants grow?—L. K. W., Los Angeles, Calif.

A.—UNDER normal conditions, the average plant shoot will grow about 1/100,000 inch a second. This means a growth of one inch every 278 hours or eleven and one half days.

World's Largest Teeth

R. K., SEATTLE, WASH. An elephant tusk often weighs as much as seventy-five pounds. In reality, a tusk is merely an overgrown front tooth.

It All Depends

Q.—HOW long must the string on a simple pendulum be to give a period or swing of exactly one second?—H. B., Tampa, Fla.

A.—LOCATION plays an important part in the length of a simple pendulum since it varies with the acceleration of gravity. At New York, a simple second pendulum has a length of 39.1017 inches or 3.2585 feet.

Practice Makes Perfect?

T. W., BALTIMORE, MD. Seven hours of rehearsing are required on the average for each one-hour radio program. Technicians and control operators as well as artists must rehearse their roles many times before going on the air where a slip or lack of coordination is costly.

Old Enough To Know Better

Q.—HOW OLD is the earth and how is its age determined?—K. N., Boston, Mass.

A.—USING a so-called "radioactive time clock method," scientists have determined the age of the earth by measuring the amount of radioactive materials in rock and then figuring its ratio to the amount of lead present. According to latest computations, the earth is at least 1,725,000,000 years old.

Dust and Rain

Q.—IS IT true that if it were not for the dust in the air the earth would be rainless? —A. Y., Tucson, Ariz.

A.—WITHOUT dust there would be no rain. The minute specks floating in the air provide surfaces on which the tiny particles of moisture condense to form drops of rain. The hundreds of thousands of dust particles that fill every cubic inch of air also are responsible for the bright red skies at sunset.

A One-Sided Argument

Q.—A FRIEND argues that all sides of the moon have been viewed by astronomers. I claim that only half of the moon's surface has been seen. Who is right?—F. H., Des Moines, Iowa.

A.—ONLY a trifle more than half of the moon, six tenths to be exact, has been seen from the earth. The far side is never turned toward us because the moon is a satellite revolving around the earth in a fixed position as if it were a ball fastened to the end of a piece of string.

Enough for Billions of Eggs

Q.—HOW MUCH salt is there in the sea and how did it get there?—L. C. H., Chicago, Ill.

A.—SOME FIVE million cubic miles of salt are contained in the sea waters of the world; enough to cover the entire United States with a layer more than a mile and a half thick. It is believed that primordial sea water was relatively fresh but the quantities of salts and chemicals carried to it by rains and rivers have gradually increased its salinity. It is estimated that more than 63,000 tons of sodium alone are carried to the sea each year.

Preserving Leaves

T. J., DENVER, COLO. To preserve specimens of tree leaves, spread them smooth and press them flat under layers of hot sand placed in a flat pan. The sand should not be any hotter than the hand can bear. When the sand has cooled, carefully remove the leaves, smooth them with a hot iron and dip them in varnish consisting of gelatin (11 oz.) and concentrated glycerin (9 oz.). Finally, allow them to dry. In making the varnish, first soften the gelatin in cold water and then dissolve it in the glycerin heated to about 212 degrees Fahrenheit.

First Reckless Driver

Q.—WHO INVENTED the first motor-driven vehicle?—J. F., Detroit, Mich.

A.—IN AN attempt to motorize the French artillery, Captain Cugnot built the first motor wagon in 1769. It was a three-wheeled affair driven by a bulky steam engine. Unfortunately, its life was short. While skyrocketing along a road at the terrific speed of two and one half miles an hour it crashed into a stone wall and was wrecked.

Goldfish Per Gallon

F. T. Y., YOUNGSTOWN, O. In arranging an aquarium, it is safe to figure two goldfish to every gallon of water. Globes are not recommended as aquarium containers since they present only a relatively small open surface to the air. If the aquarium is to be placed near a window, one furnishing north light is best. Direct sunlight should be avoided.

Winter and Thunder Storms

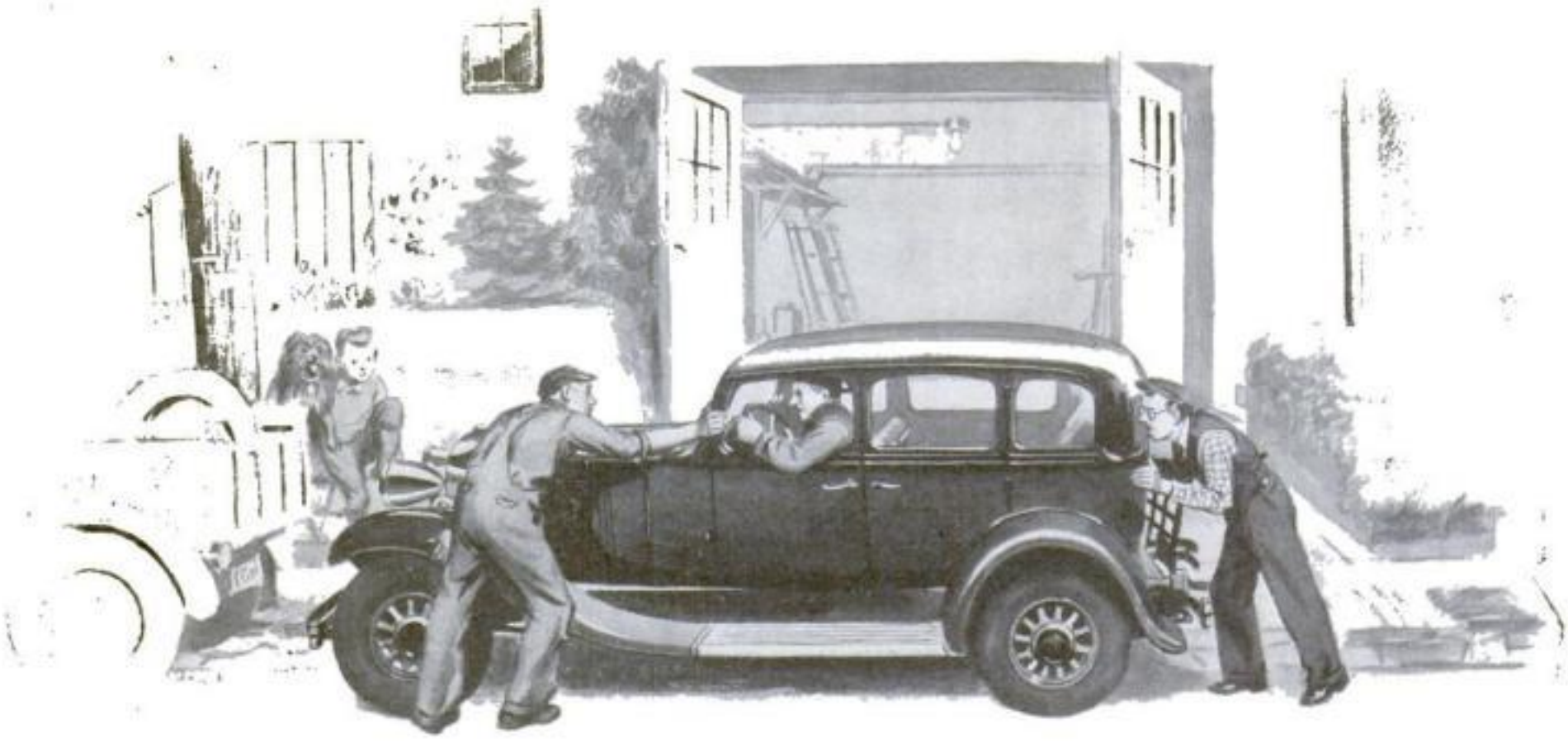
Q.—WHY ARE thunder storms more common in summer than in winter?—Z. L., San Diego, Calif.

A.—VIOLENT storms such as thunder storms are caused by great differences in the temperatures of crossing air currents. Such differences are commoner on the hot days of summer when heated air rises from the earth than in the winter.

Warmth from Smoke

Q.—HOW DO the smudge fires or smoke pots placed in orchards help to protect the fruit from frost?—K. L. P., New York, N. Y.

A.—IT IS the heavy smoke, not the heat, that protects orchards from frost. Forming a cloud, it blankets the ground and the trees and prevents the radiation of heat, often keeping the air close to the earth four or five degrees warmer than the surrounding atmosphere. *(Continued on page 121)*



Gus and Joe pushed and pulled until the car rocked back and forth. Suddenly a click was heard from near the floor boards

GUS TELLS WHAT TO DO

When Your Starter Balks

By **MARTIN BUNN**

DAVE MORRISON settled himself behind the steering wheel of his car and jabbed confidently at the starter button. Instead of the expected whine from the motor, there was a metallic clank and a straining groan.

"Now what—" Dave exclaimed helplessly.

Ned Rogers, who was sitting beside him, scratched his head. "Never heard anything like that before," he confessed. "Try it again."

But the second try proved no more successful than the first. Only a faint growl was heard. The motor failed to spin.

As a last resort, Dave decided to try the hand crank. "It's no use, Ned," he grunted, as he placed his full weight on the crank handle. "I can't even budge her. Seems like she's frozen stiff. You better run on down to the office before you're late. I'll give the Model Garage a ring and see what they have to say."

When Gus Wilson and Joe Clark drove up in the Model Garage wrecker a few minutes later, Dave Morrison's head was buried under the open hood of his car.

"What's the matter?" asked Gus as he swung to the ground. "This cold spell got the best of that motor already?"

Morrison shrugged his shoulders. "Blamed if I know. One thing sure, she won't turn over and all the starter does is groan. Here, listen to it," he commanded, climbing into the driver's seat and holding down the starter button.

"Whoa! That's enough!" broke in Gus almost at the first note of the groan. "Put her in high gear and let up on that emergency brake. I want to try something." As he spoke, he walked to the front of the car and motioned Joe around to the rear.

"Now, have you got her in high?" he asked. Morrison nodded.

"O. K. then, Joe, let's go."

With that, he and Joe began pushing and pulling until the car rocked back and forth in an even swing that almost tossed Morrison from his seat. Suddenly, a loud click resounded from the vicinity of the floor boards.

"There," said Gus, "that ought to fix it. Now put her back into neutral and step on the starter again." This time, the hum of the starter motor told a different story. The very first touch of the button set the motor spinning.

"I'll be hanged!" Morrison cried. "What in blazes was the matter with it anyway?"

Gus chuckled. "Inertia gear was stuck," he replied.

Morrison looked at him blankly. "What was stuck?"

"The drive gear on your starter," explained Gus. "You know how that works, don't you?" The puzzled frown on Dave Morrison's face showed plainly that he did not know.

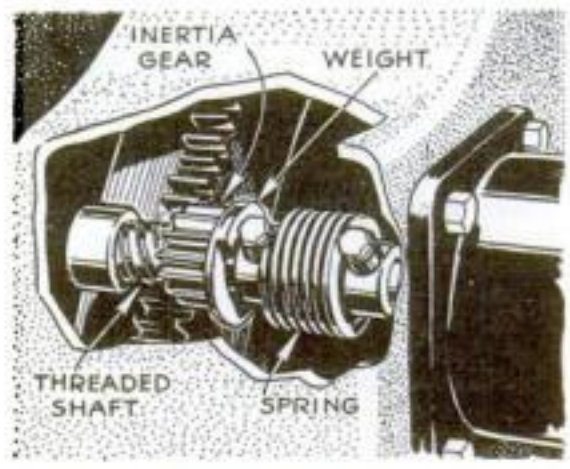
"Come around here, then, and I'll show you," said Gus as he unlimbered the side of the hood and selected a wrench from the tool roll Joe had spread out on the running board. "First of all, we'll unscrew these two studs that hold the starter motor in place, loosen these switch connections, and take a good look at what's inside."

As Gus worked at the studs, Joe supported the body of the starter motor. When the two studs were freed, the motor dropped and Joe carefully pulled its long drive shaft from the hole in the casting that housed the flywheel. The starter looked like any other electric motor except for the shaft projecting at the end.

"See this?" Gus asked, poking the shaft with one end of his wrench. "That's what hooks up the starter motor and the teeth on the flywheel. Inertia drive, it's called. Not every car has one, but yours is one that has."

Dave studied it carefully.

"If you'll look," continued Gus, "you'll notice that it's a threaded shaft with a counterweighted gear that runs in the threads. Now when you step on the starter button, the electrical circuit to the starter motor *(Continued on page 130)*



Perspective showing general construction of the inertia-type starter drive gear

SIMPLIFIED Tesla Coil

Gives 200,000-volt Current for Many Dazzling Experiments

By Kenneth M. Swezey

Taking 200,000 volts without a shock. At such high frequency, the current travels on the surface of the body and is entirely safe

PURPLE streamers of sparks from eight to ten inches long, potentials of several hundred thousand volts, beautiful fountains of brush discharge, wireless lights, high-frequency currents that may be taken into the human body without harm and used to perform dozens of amazing experiments—all these are at the instant command of the home experimenter who builds a simple resonance transformer or what is usually called a Tesla coil.

Spark candelabra made by untwisting and fanning out part of a short length of aerial wire of the type with seven strands

Home-built Tesla coil in action. It may be used for many remarkable high-frequency experiments

Of all the shapes and sizes a Tesla coil may take, the present coil has been chosen as particularly inexpensive, easy to construct, and yet large enough to perform most of the more spectacular experiments. If the prospective builder happens to be a radio amateur of the old "spark" days and still has the remains of his transmitting apparatus, the whole outfit may be assembled for less than $1.50. If he must buy or build a high-voltage transformer, condenser, spark gap, and tuning inductance, the cost may climb from $10 upward, depending upon the type of equipment desired.

The first essential is a high-voltage transformer capable of stepping up the 110-volt A.C. house current to from 10,000 to 15,000 volts. An old ¼- or ½-KW. amateur transmitting transformer is ideal, or a transformer of the kind used for lighting neon signs may be used. Used or rebuilt transformers of the latter type may be bought quite cheaply from any neon sign repair company. For home workers who wish to build their own, an article on the construction of step-up transformers will appear in a later issue.

A flat tuning coil, consisting of a spiral of about twenty turns of copper or brass ribbon, ½ in. wide and spaced about ¼ in. apart, with a sliding contact, is perhaps the most compact and easily adjusted. Such coils, as parts of discarded amateur or Navy transmitters, may often be picked up in second-hand electrical shops for less than a dollar. A coil simpler to build may be made by winding a helix of twenty turns of No. 6 bare copper wire on a cylindrical form of notched wooden strips, 8 in. in diameter, with the turns spaced about ⅜ in. The lower end of the coil should be connected to a binding post. The other connection may be made by means of a spring clip, which may be snapped on the heavy wire at any position required.

Any type of spark gap familiar to the old radio amateur may be used. A quenched gap is preferable where silence and utmost efficiency are desired. A rotary gap is almost as effective. An ordinary straight gap, however, with a small electric fan blowing across the electrodes, will serve satisfactorily.

Upon the condenser depends a great deal of the final effectiveness of the entire out-

In making the condenser, sheets of metal foil are rolled down on sheets of glass coated with beeswax

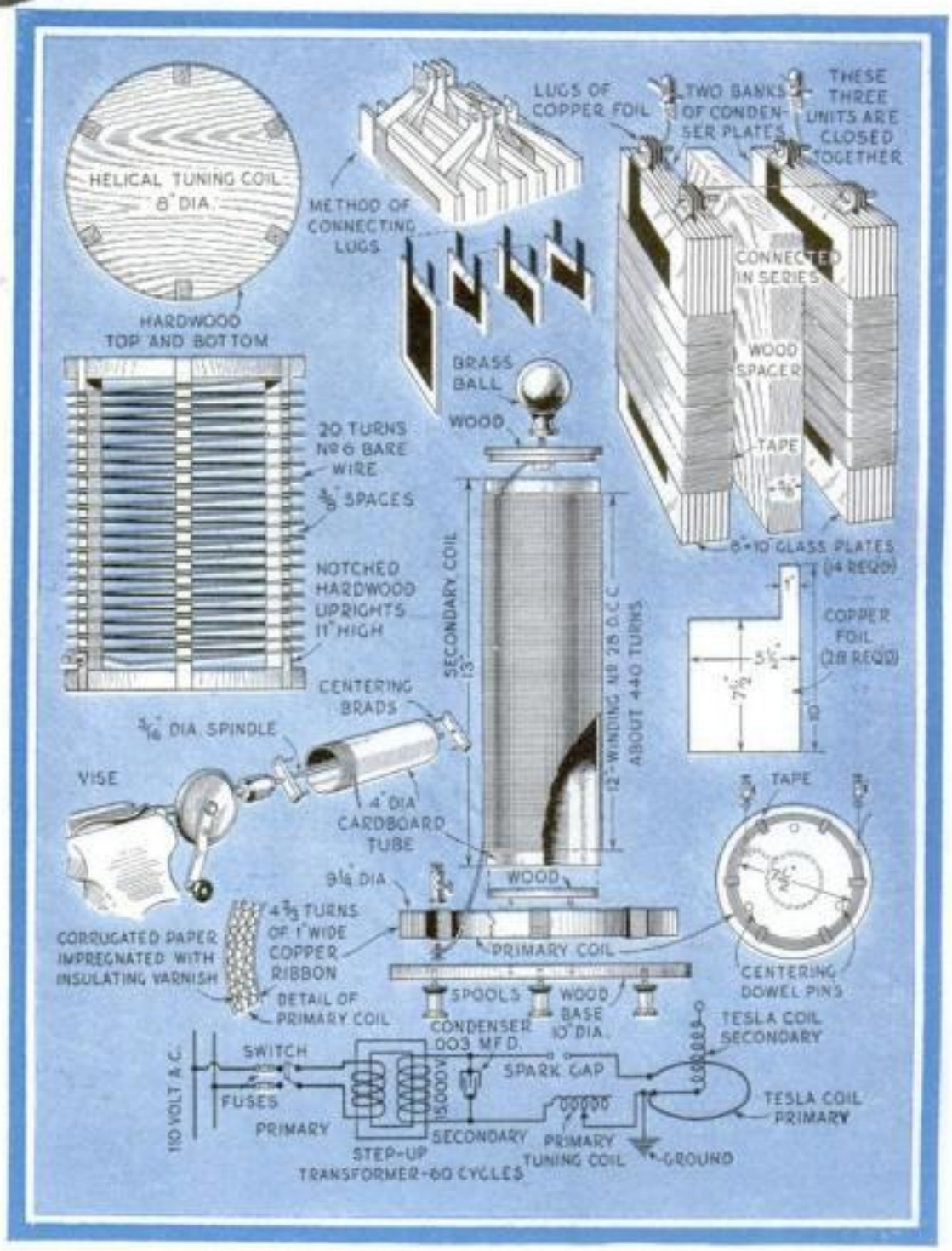
fit. For compactness combined with minimum loss, the high voltage mica condenser stands in a class by itself. If the experimenter can obtain a mica condenser with a working voltage exceeding that of his transformer secondary, and a capacity between .002 and .004 microfarads, his condenser problem will be solved.

His next best bet is to make a condenser with metal foil and glass plates. Select fourteen 8 by 10 in. photographic plates that are free from large air bubbles and scrape off the emulsion after wetting the plates with warm water. Next, cut twenty-eight pieces of thin copper foil or heavy tinfoil as shown.

Some builders apply the metal-foil coatings to the plates with shellac, but the writer has had better results with beeswax. Heat the plates gently in an oven or at a distance above an electric grill or gas flame, and rub a piece of beeswax over one side of one of the plates until a thin coating has been distributed over the entire surface. Before it cools, quickly center one of the pieces of foil on the wax coating and press it into firm contact by means of a photographic roller. The lug should extend 1¼ in. above the top of the plate. While the plate is still warm, turn it over and apply the wax and foil to the other side, this time attaching the foil so that the lug comes up at the opposite side.

When seven plates have been completed, bind them tightly together with insulating tape. As a further precaution against brush discharges around the edges, this unit may be boiled for a few minutes in a mixture of one part beeswax to one part rosin, or in one of the compounds made by insulating supply houses especially for the purpose. If properly assembled, seven lugs should be grouped at each side. A hole should be punched near the ends of the lugs, and each group clamped tightly together with a brass bolt and nuts.

The second unit of seven plates should be treated similarly. A wooden spacer, ⅝ in. thick and the size of the plates, should be placed between them, and the two units connected as shown in series-parallel. If desired, the whole condenser may be put into a wooden box (built preferably without nails or screws), which has been thoroughly impregnated with hot wax or insulating varnish, and



How to construct the tuning coil, condenser, and Tesla coil proper; the wiring diagram; and a sketch of an improvised winding device

the terminals led to binding posts on the top.

The materials required for the Tesla coil itself include a cardboard tube, 4 in. in diameter and 13 in. long; ½ lb. of No. 28 double cotton-covered wire; about 10½ ft. of copper or brass ribbon, 1 in. wide; three ordinary small spools; two binding posts; corrugated cardboard; ½ pt. insulating varnish; a brass bed ball; a wooden disk for the base, 10 in. in diameter; wooden disks for the top and bottom of coil; dowels, glue, and tape.

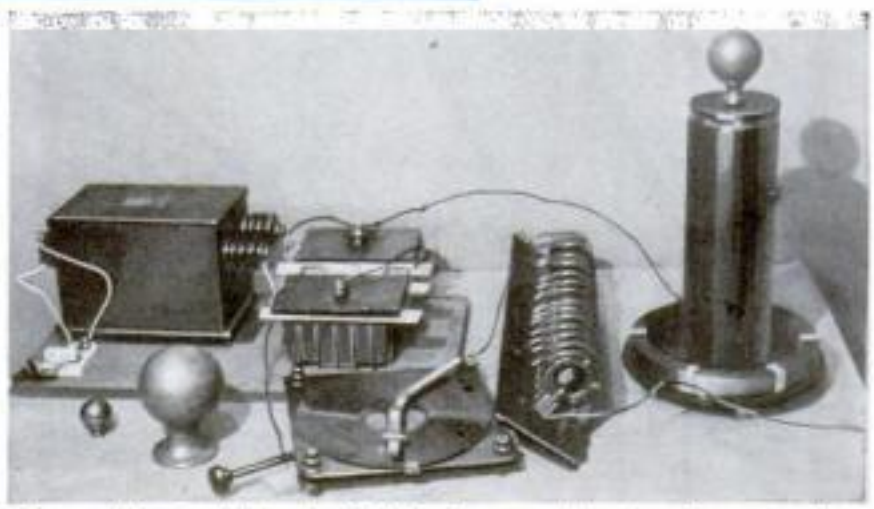
Because of the tremendous voltages produced, great attention must be paid to insulation. All the wooden parts and the cardboard tube should be thoroughly dry and treated with several coats of air-drying insulating varnish, which may be obtained wherever electric motor and transformer repair work is done. Dowels should be used instead of nails or screws for holding the parts together.

For the base, the writer used a circular bread board. Its legs are three spools, held by glue and dowels. A wooden disk, about ½ in. thick and large enough to fit snugly within the cardboard tube, is doweled to the center of the upper surface of the base.

The primary coil may next be constructed. Cut enough strips of corrugated cardboard about ¾ in. wide to make a length totaling about 9 ft. Soak these thoroughly in the varnish. Bend a neat loop in one end of the copper strip, large enough to pass the bolt that will hold one of the binding posts. Then, using a round can or box 7½ in. in diameter as a form, start winding the primary. Wind just 4 2/3 turns, with the varnished corrugated board as a separator. At the outer end of the strip, bend another loop for the bolt of a second binding post. After sliding the coil from the form, the turns may be bound tightly together by six bands of adhesive tape. Half a dozen 3/16-in. dowels, set into the base in a circle of 7½ in. outer diameter, will hold the primary.

The secondary may be wound either by hand, on a lathe, or with a simple winding

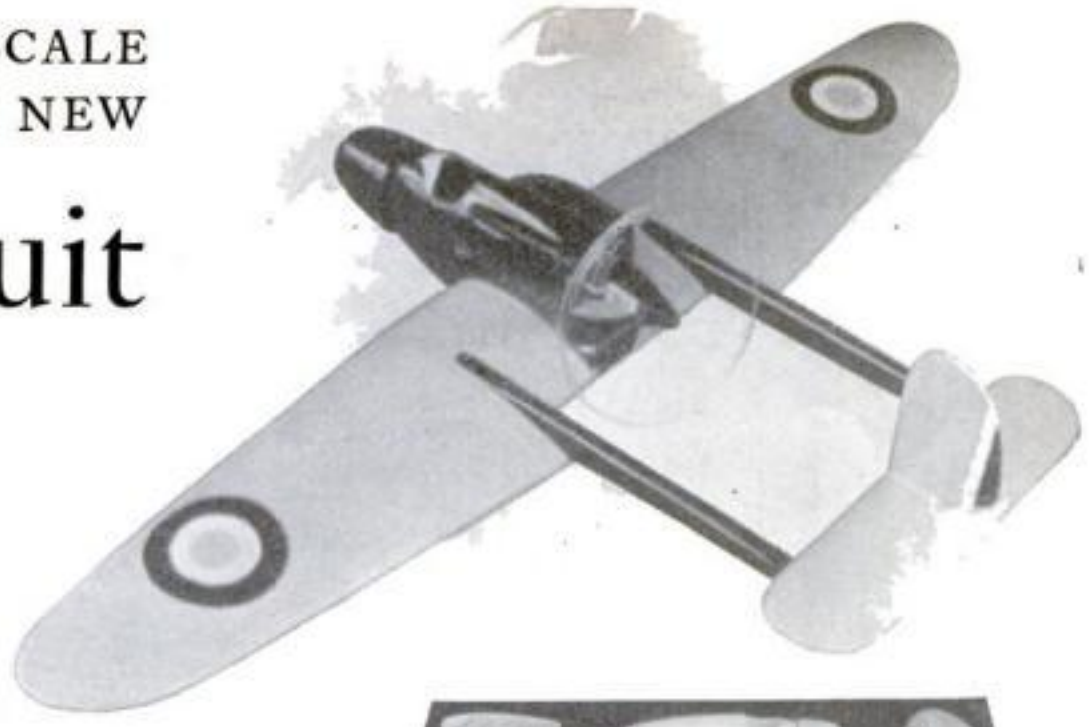
(Continued on page 115)



From left to right: A 12,000-volt neon sign transformer, mica condensers, tuning coil, quenched spark gap, and the Tesla coil

HOW TO BUILD A SOLID SCALE MODEL OF A REMARKABLE NEW

French Pursuit Plane



By DONALD W. CLARK

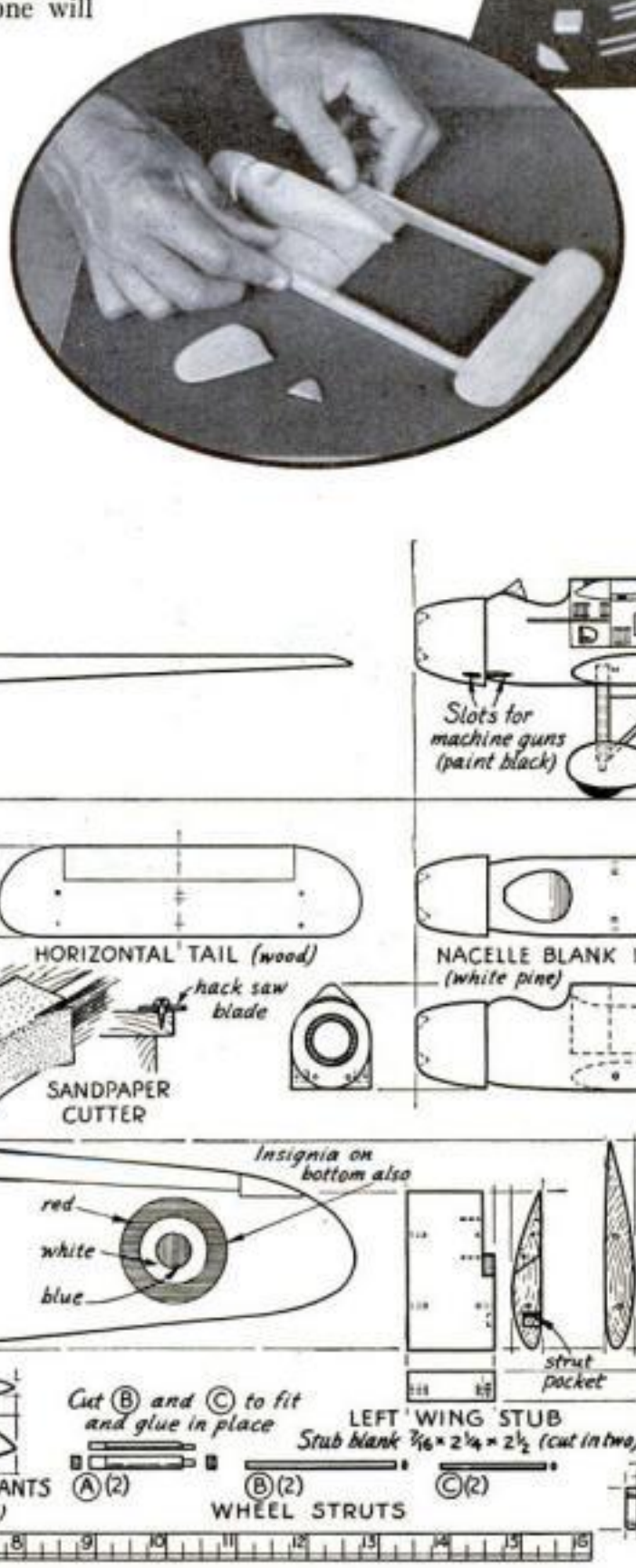
OF STRIKING appearance, the new low-wing French pursuit plane, the Hanriot-Biche, makes a model that is distinctly out of the ordinary. The scale of the model in relation to the full-sized plane is ⅜ in. equals 1 ft.

White pine is the most suitable wood for the main parts, and balsa wood can be used for the "pants," valve covers, and part *D*. If desired, the nacelle can be made of three pieces, the nose cowl and the propeller cone being carved separately. In the model shown in the photos, however, the nacelle was made in one piece, and no doubt this is the easier method. Small slots cut into the cone will serve to hold the propeller blades. Simply roughen the ends of the blades with a knife point and set them in glue. The nose cowl "dish pan" can be cut in with a sharp-pointed knife and smoothed with sandpaper wrapped around a small stick. Cut in the cockpit before rounding the nacelle.

Color are applied as follows: nacelle landing gear, tail booms, and tail-wheel mount, bright red; wings, horizontal tail, and vertical tail, yellow; tires and trim, black; nose "dish pan," gray. Outline the ailerons, elevator, rudder, and nacelle markings with a hard pencil before painting, and press the lines heavily in.

HANRIOT-BICHE MODEL

Only twenty-seven parts are needed to make this model. The larger units can be fastened with wire pins and nails or, if preferred, with cement or glue alone. The original plane is a three-bladed pusher, powered with a 600 H.P. water-cooled Hispano Suiza engine. A ring type radiator is set inside the nose cowling and another, which is rectangular, is attached directly below the nacelle itself



Working drawings with a scale for finding the dimensions of the various parts. The wing stubs may be made integral with the wings, if desired

BLUEPRINTS for Popular Science Monthly projects are listed on page 90.

YOU CAN SAVE A LOT BY BUILDING THIS Beautiful

A chair of this quality is very costly, but any amateur craftsman can make one like it if he will take sufficient pains

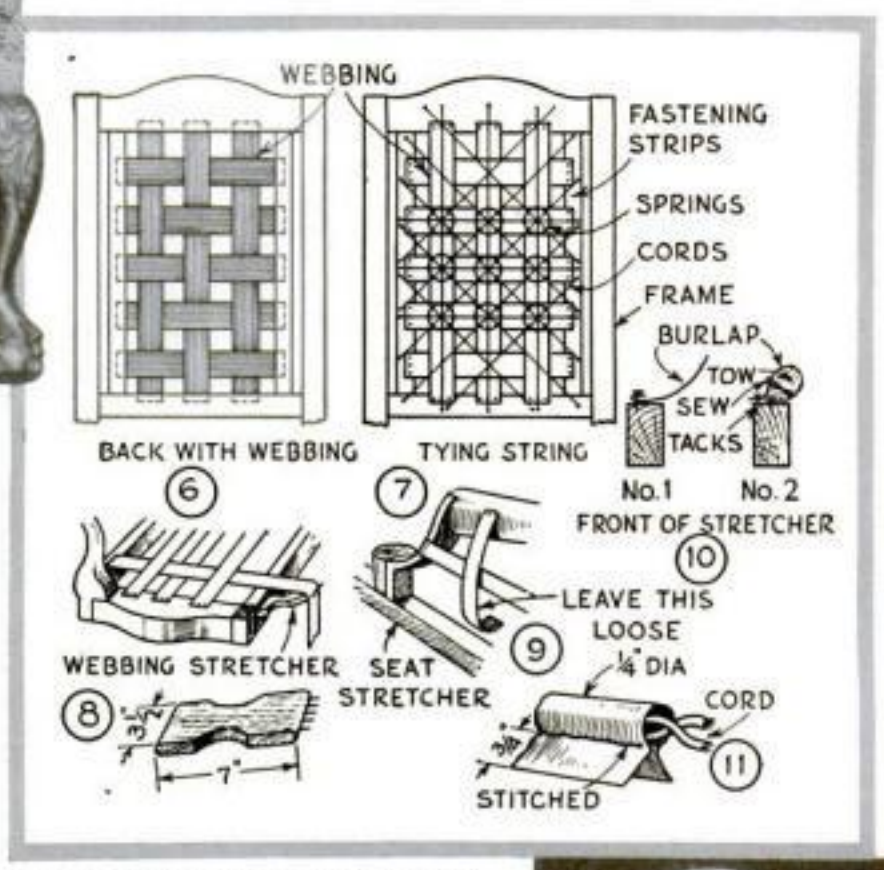
A WING chair is as comfortable and cozy a chair as can be bought, but the price of a good one being beyond the reach of the writer's purse, he finally decided to build one. In designing it, the best traditions of the chair maker's art, as practiced during the eighteenth century, were followed.

The front legs are carved from a piece of solid mahogany 3 in. square and 16½ in. long. Two blocks of mahogany, 2½ by 3 in. and 3½ in. long, are glued to each leg 2½ in. from the top to give sufficient stock for the flare. After the mortises have been cut and the blocks glued on, the legs are marked by means of a pattern cut from a piece of flexible cardboard. This is later used to make the stencil with which to lay out the carving on the leg (Fig. 4). The pattern is transferred to one side of the leg, which is then band-sawed. The adjacent side is marked for the next sawing. The leg is now shaped, but is still square in section (Fig. 5). It will have to be rounded with spokeshave, chisels, and file. In carving the foot, it is best to block out the toes and leave them until after as much as possible of the ball has been formed. When the toes are being carved, keep each knuckle the same distance from the floor. The carving on the knee requires time and care, but is not difficult. Outline the leaves with a V-tool, then cut away the background, and finally model the leaves.

No great difficulty should be experienced in constructing the rest of the frame, except, perhaps, the arm supports. They are made from hard poplar blocks, 3 by 5 by 11 in. First saw to the shape given in Fig. 3, then cut to the shape shown in Fig. 2. It may be necessary to fill out a place or two with an extra piece of wood to get the proper shape, as shown in the photograph of the frame.

The finish on this chair consists of a coat of oil stain, a thin wash coat of shellac, and two coats of varnish, rubbed down with pumice stone and oil.

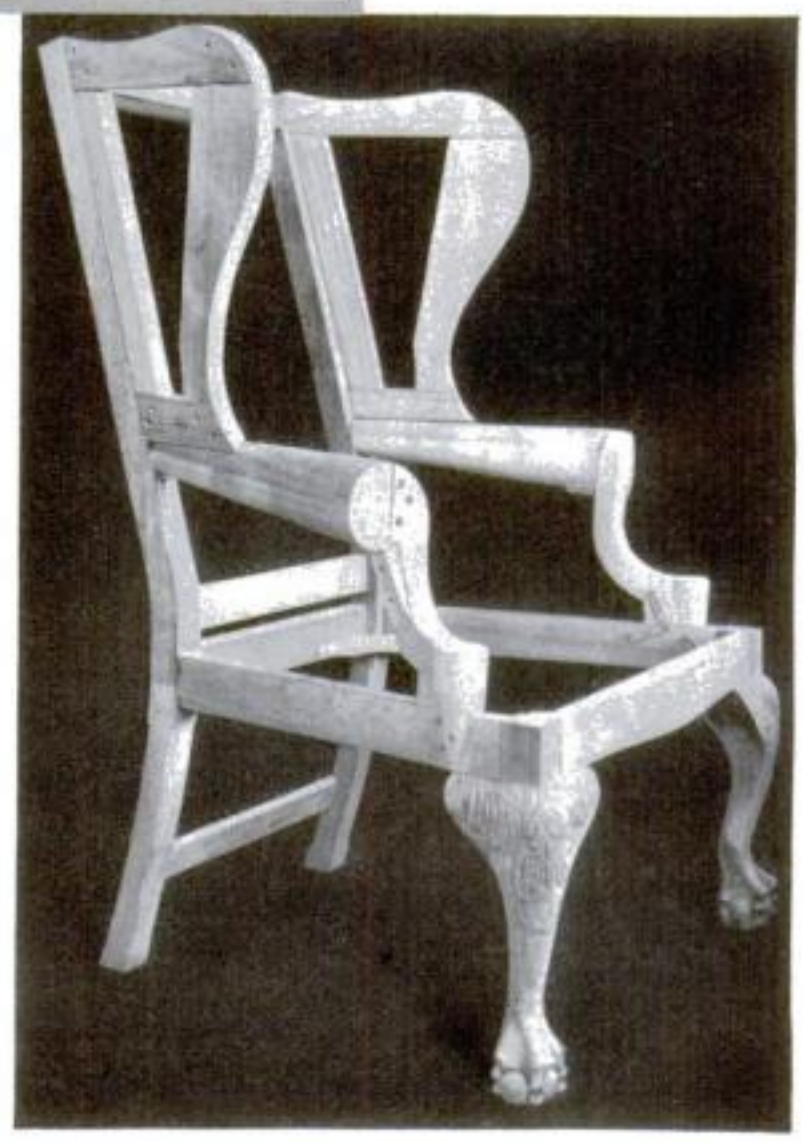
To upholster the chair proceed as follows: Tack good hemp webbing to the bottom of the seat frame, to the outside of the back, and to the inside of the arms and wings. The webbing must be interwoven, stretched, and tacked with 12-oz. tacks (Fig. 6). The webbing is first tacked at one end, then stretched as shown in Fig. 8, and tacked before being cut. Double the ends of the webbing over the first few tacks and tack through the double thickness. The vertical webbing on the inside of the arms is tacked to the outside of the seat frame, after the upholstering on the inside of the arms is all in place. It is necessary to leave it unfastened at the bottom so that the burlap, muslin, and upholstering material can be drawn down and tacked to the outside of the seat stretcher. When this has been done, the webbing may be pulled tight and tacked. By fastening the upholstering material, muslin, and webbing to the outside of the seat stretcher, the top of the stretcher is left free to tack the burlap and muslin which cover the springs of the seat (Fig. 9).



Diagrams showing the general method of applying the webbing and making rolled edges and welts. The complete framework is illustrated at the right

For the back of the chair, nine 4-in. pillow springs are sewed with twine to the webbing at the places where the strips intersect. Use an overhand stitch. Twelve heavier seat springs are sewed to the webbing in the seat. Tie the springs eight times with heavy twine (Fig. 7), using a weaver's knot. The twine must be stretched in such a manner that the springs may be compressed without tearing or loosening the twine where it is tacked. It must be taut enough, however, to hold the springs straight.

When tied, the springs must be covered with heavy burlap. About three yards will be needed. Pull it through the opening between the back legs and the vertical strips *A*, Fig. 2, and tack it with 6-oz. tacks to the back of these. After the filling material has been put on the back, the muslin which covers it and also the upholstering material are drawn through this opening and tacked in a similar manner. At the bottom of the back, the materials are drawn through the opening between the seat rail and the stretcher above the seat rail and tacked to the back of the latter. They are drawn to the back, to be tacked at the top of the chair. The webbing on the arms and wings must also be cov-



Chippendale Wing Chair

By Franklin H. Gottshall

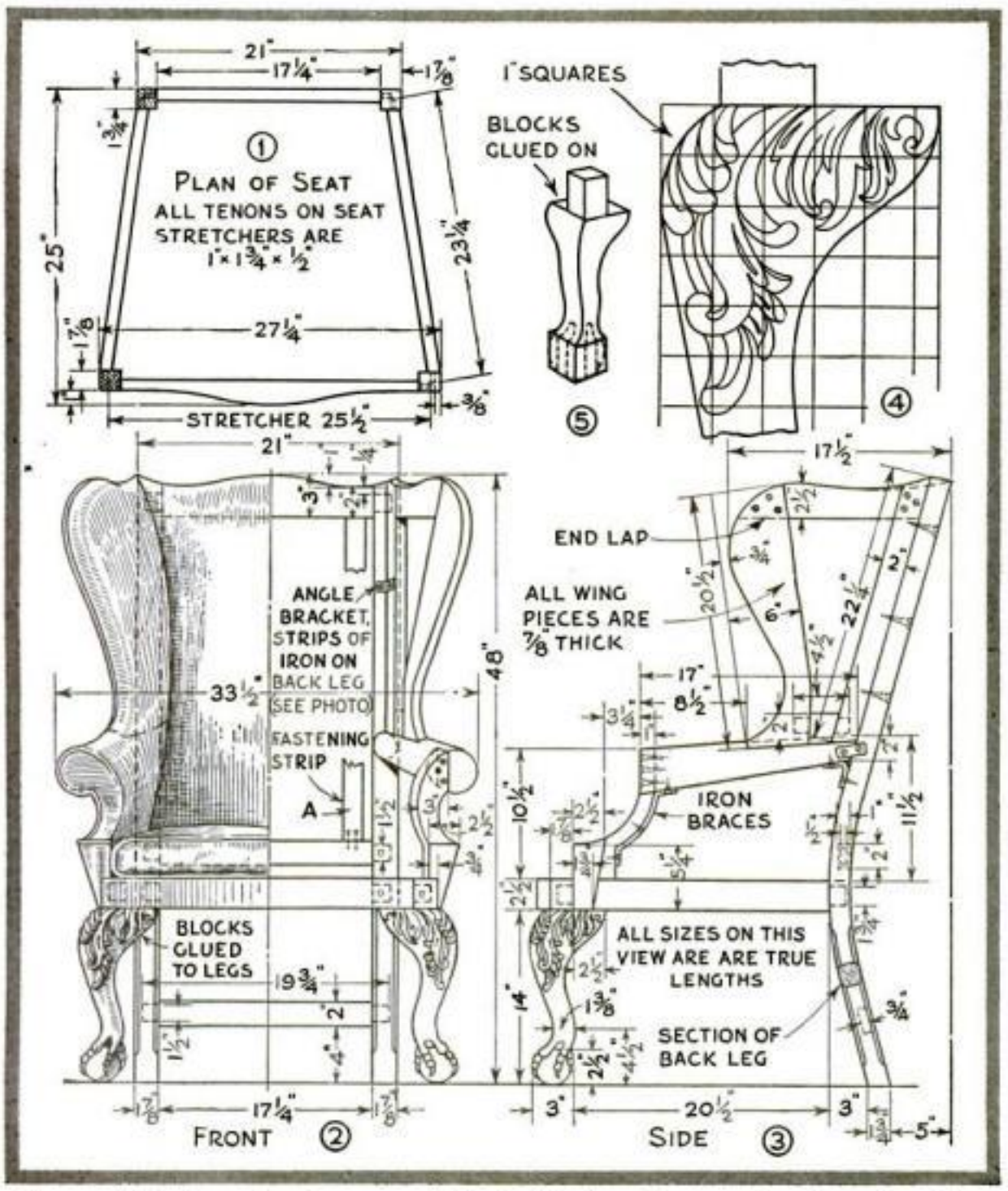
ered with burlap, to which the filling may be sewed.

After the burlap has been tacked in place, the chair is laid on its back and a 5 or 6 in. thick filling of moss is evenly distributed over it. This thickness is considerably reduced when the muslin is stretched over it. Long loops of twine are sewed all over the burlap. When the moss is worked into these loops, they prevent it from sliding about. The moss is first "picked" (pulled apart) to form a springy mass. Not all of the moss need be pulled through the loops—only enough to hold the upper surface of the layer to itself.

The insides of the wings and arms are padded in the same manner, though the filling will vary in thickness from about 1 in., or a little more, around the tops of the arms, to a greater thickness where it is needed. Great care should be taken to keep the filling springy and uniform. The muslin is now stretched over the filling, one surface at a time. The seat should be done last of all. A thin ice pick may be used to shift the moss after the muslin has been stretched, where this is necessary to get the surface smooth. This surface will be considerably improved if a thin layer of cotton felt is placed over the moss before the muslin is stretched over it.

The seat, at the front, has a built-up roll edge, consisting of a roll of tow incased in burlap and tacked to the top of the seat stretcher (Fig. 10). This roll is made fairly hard by sewing a running stitch along its entire length after it has been tacked in place. A piece of upholstering material 7 in. wide must be sewed to the muslin at the front of the seat. This is tacked to the front seat stretcher, along the outside, and to the side stretchers, back as far as the rolls of the arm supports. The tacks holding it will be covered later by the strip of material shown at the lower edge of the seat in the photograph of the finished chair.

No chair can surpass a correctly designed, well-upholstered wing chair in comfort, and it is, at the same time, highly ornamental



Front and side views, plan of seat, one of the foot blocks, and a pattern for the carving. Many parts, being at an angle, are longer than they appear to be, so the true lengths have been marked

The upholstering material—7½ yd. of 38-in. width—used to cover the chair shown was a hand-woven tapestry in an old Colonial coverlet design, known as the "big diamond." A plain material, purchased from a dealer, will serve the purpose, however.

Cover the inside of the wings and arms first. Cut a pattern from heavy wrapping paper, and in cutting the cloth, take considerable care to match the material, so that the figure will go in the right direction and be well balanced. Allow several extra inches of cloth for stretching. The easiest way to cover the wings and arms is to sew a seam directly above the arm, joining the wing cloth to the arm cloth at that place. The writer used only a single piece of cloth for the wing and arm, but this is considerably more difficult to fit. Slip-tack the material to the rear of the back leg; that is, the tacks are not completely driven, which allows them to be removed and the cloth restretched as the fitting progresses. Use 3-oz. tacks and always tack from the center to the ends. The inside wing cloth is drawn around and tacked to the outside of the wings.

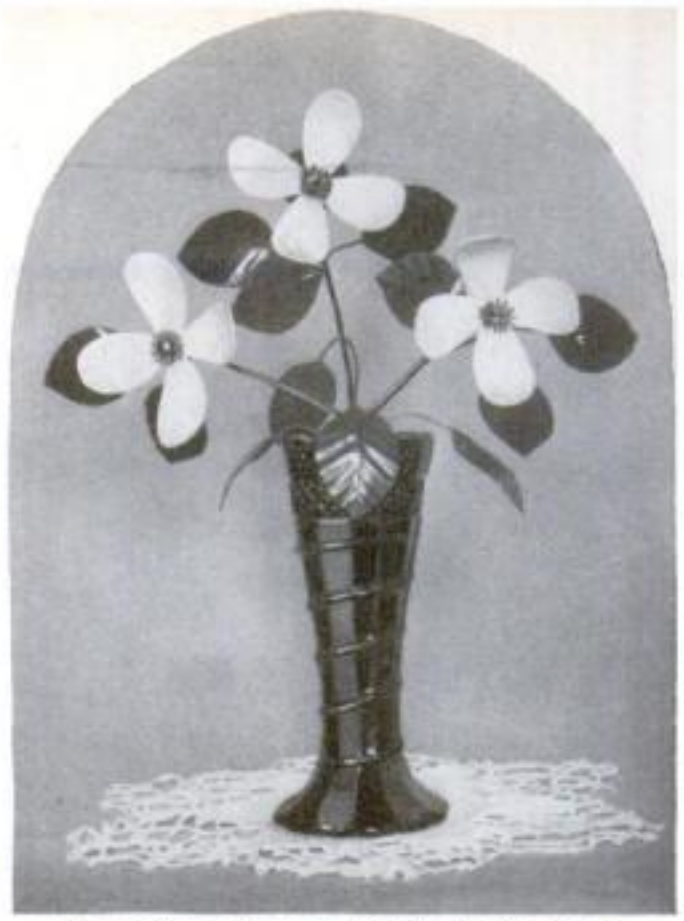
The material covering the arms is tacked to the outside of the seat stretcher at the bottom, after which the webbing may be fastened as mentioned before. At the top it is tacked under the arm roll and sewed to the wing material with a curved upholsterer's needle, using a blind stitch. The cloth for the back (inside) is fastened next. It is tacked to the rear of the vertical strips.

The welt consists of cording of some kind, covered with upholstering material (Fig. 11). A *(Continued on page 103)*

Dogwood Bouquet

formed from

TIN *and* WIRE



Decorative arrangement of dogwood blossoms and leaves made entirely of metal. Because of their modernistic quality, ornaments of this type are now enjoying a popular vogue

A PERMANENT bouquet of dogwood blossoms to decorate your home can easily be made by anyone handy with tin snips and soldering iron.

The materials required are a tin coffee can, some copper wire, white and green enamel or lacquer, and solder. First make patterns for the petals and leaf by marking out ½-in. squares on paper and using them as a guide to copy the design. For the bouquet illustrated, three sets of petals are needed, so they are cut from tin to match the pattern. A hole to take a No. 14 wire is punched in the center. The petals are then bent to shape with the fingers, enameled white, and hung up to dry.

Thirteen tin leaves are required. They are ribbed to make them appear more real. This is accomplished with pliers having a straight side. First fold them from end to end, then from the center out as shown in one of the drawings.

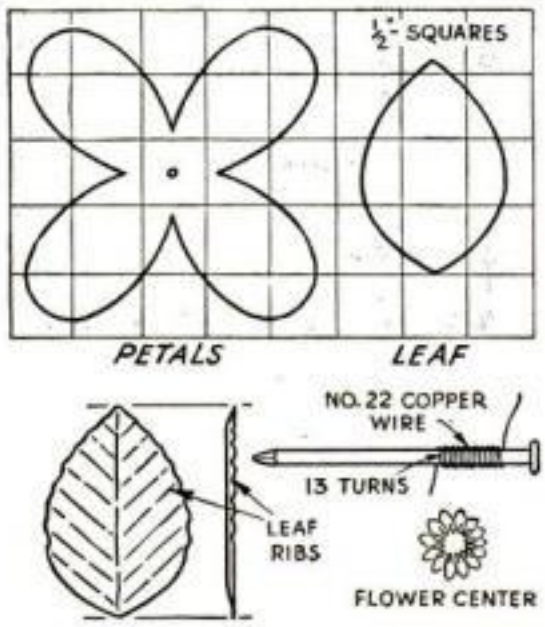
Solder 4-in. lengths of No. 18 copper wire on the leaves for stems. Enamel the leaf, but leave the stem bare.

To make the center of a flower, take some No. 22 copper wire and wind it on an 8-penny nail to form a neat coil spring. About thirteen turns are necessary for each flower. Bend this coiled wire so the ends meet, and hook them together. Solder this doughnut-like coil to the end of a No. 14 copper wire about 10 in. in length. Dip the coil in green enamel and let dry.

When the enamel on the various parts is dry, you can start assembling. Slip the petal part of a flower on the stem and wind a few turns of fine wire in the back to hold it in place. Secure with a little solder, being careful not to unsolder the flower center by using too much heat.

The flower stems are soldered together, and then the leaves are soldered on. A good way to handle the leaves is to solder three together, and solder the group to the main stem.

Now arrange the flowers and leaves into an attractive bouquet and paint the stems.—BASYLE PALMER.



BLACK CAT DISPLAYS HOUSE NUMBER

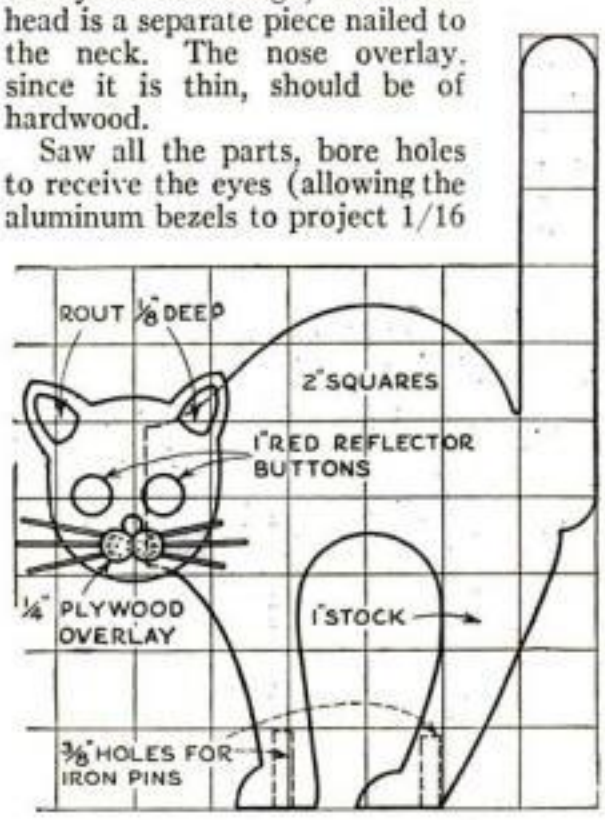
ARCHING his back in welcome, this black cat is a striking novelty to set at the entrance of the driveway. His eyes, which are red reflecting buttons, glow at night when the headlights of a car flash upon them.

The body, legs, and tail are cut from a 12-in. board with the grain running vertically in the design, while the head is a separate piece nailed to the neck. The nose overlay, since it is thin, should be of hardwood.

Saw all the parts, bore holes to receive the eyes (allowing the aluminum bezels to project 1/16 in.), and gouge or rout the ear openings to a depth of about ⅛ in. before nailing the cat together. Also, gouge grooves in the back of the nose piece to receive the whiskers, which are 16-penny box nails. At the back, where the neck overlaps the head, round the corner to a radius of ¾ in.

A twisted piece of a dry tree branch is a suitable base. Bore it and the cat's feet to take ⅜-in. round iron pins for holding the whole upright. Paint the body black and the whiskers red, and align the aluminum figures to conform to the arch of the back.—EDWIN M. LOVE.

A novel way of displaying a house number prominently at the entrance to a driveway



By drawing 2-in. squares on wrapping paper, a full-size pattern can easily be prepared

COAT HANGER BRACKET

THIS attractive jig-sawed fixture will hold six wire coat hangers in a minimum of space, and it can be conveniently fastened in any nook. The shape of the hooklike projections was especially chosen to avoid the danger of sharp points. The bracket is cut from a piece of ½-in. hardwood and screwed to a ⅜ by 1½ by 14 in. wood strip, which may, in turn, be fastened to the wall at top and bottom. Seven feet from the floor is a suitable heighth. Enamel or lacquer the fixtures to match other woodwork.—E. A. B.

HOW TO COMPLETE THE HULL OF OUR NEW

Privateer Model

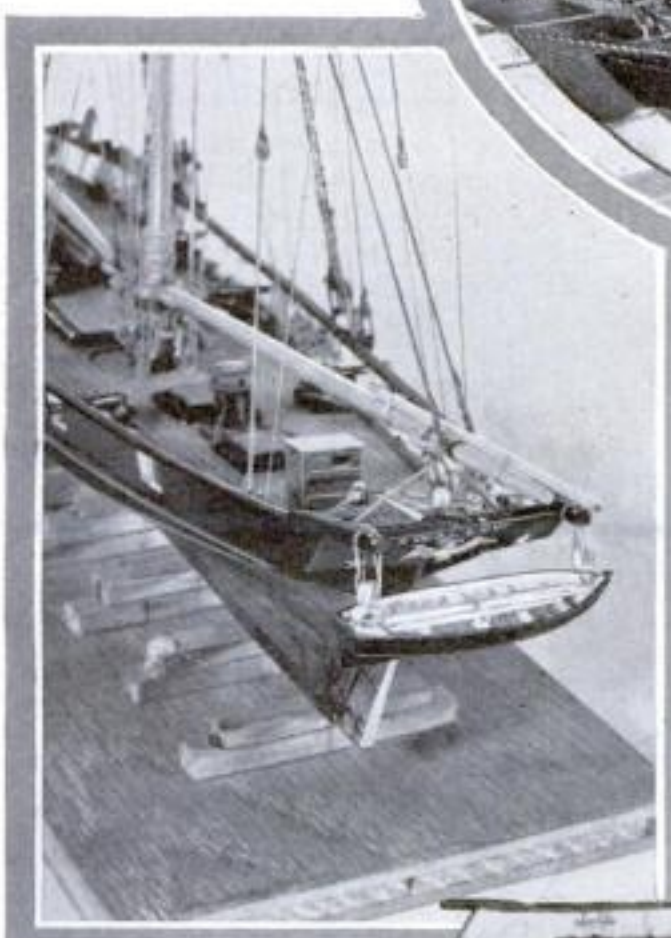
By Capt. E. Armitage McCann

This ship was a 6-gun privateer used in the War of 1812. She was 92 ft. on deck, 24 ft. beam

HAVE you started our new ship model, the *Swallow,* a privateer of the War of 1812? She was one of those Baltimore topsail schooners so famous, the world over, for their speed and the daring of their crews—picturesque to the last degree.

She makes a remarkably good-looking model because of the fine hull lines and slender spars and rigging. Another advantage is that the model, although small, is built to the scale of ⅛ in. equals 1 ft., which is an easy scale to work to.

In the last issue (P.S. M., Nov. '34, p. 65), we described the making and painting of the hull. Those who did not see that issue should look it up and get to work.



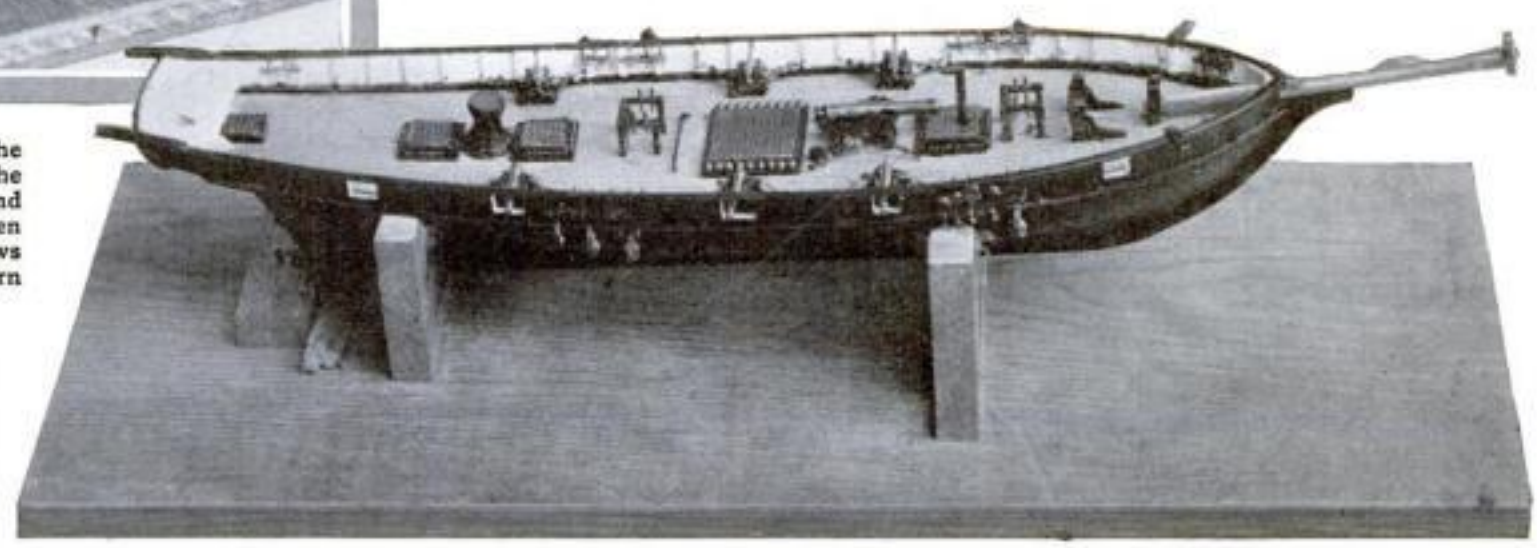
Bow view showing various fittings mentioned in this article, including the catheads, bitts, channels, and pinrails

There are a few parts of the hull proper that could not be described in that issue for lack of space. It would be more logical to apply them before the painting, but if the painting has been done, just scrape a space to glue on these other parts.

The channels to spread the rigging are four hardwood pieces, slightly thicker on the inside and with notches to take the deadeye straps. Their shape and positions were shown last month in one of the photographs and the deck plan on page 67.

As the pinrails are placed in the same positions, only inside the bulwarks, make them also. They are thinner, as shown in the deck plan and profile drawing of the deck fittings, and have to be notched to take the timber heads. Glue all these in position, then nail right through from the outside with ½-in. pins. There are also pinrails forward and aft. The belaying pins can be bought ready-made or turned from brass rod, although for a simple model headless pins, painted brown, can be used. Drill holes to make them a tight fit. If brass is used, stain it brown. I used ¼-in. pins, which are a bit over scale but as small as is practical; in fact, 5/16-in. pins would do. Note that belaying pins are indicated by solid round dots on the deck plan, and all the eye- or ringbolts by small circles drawn in outline.

The channels *(Continued on page 98)*



Four of the hatches, the capstan, the binnacle, the boat davits and boat, and several guns can be seen in this view, which shows the model from the stern

Hull with principal fittings in position. The hull itself is 13 in. long but the overall dimensions of the finished model are 20 in. long, 13½ in. high

BLUEPRINTS for Popular Science Monthly projects are listed on page 90.

Comical Fisherman Catches Ashes

A coconut is used for the fisherman's head, and, being hollow, serves as an ash container

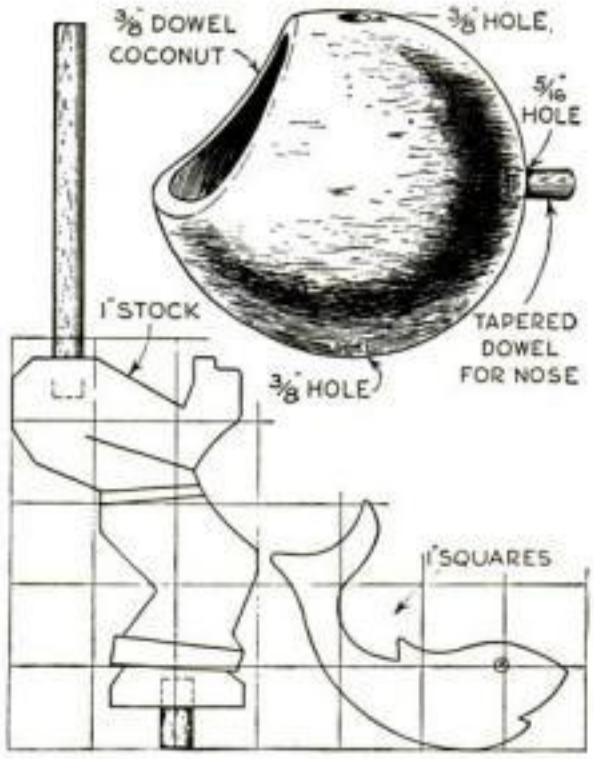
JUST look at him lean back on that rod! Watch it bend! Wotta rod, wotta fish, wotta man! And what an ash tray!

Get a coconut, wire-brush it smooth, mark off the holes—a large hole for the cigarette ashes, two ⅜-in. holes for the dowel that supports the head, and a 5/16-in. hole for the fisherman's nose. Make the holes with a small drill and ream them to the proper size. Cut out the large opening by sawing off a thin slice of the shell, and clean out the meat in the coconut.

Make the wooden parts as shown. The fishing reel is a small disk of wood ⅜ in. in diameter and ⅜ in. thick with a ⅛-in. hole bored through the edge for the fishing rod. The reel handle is a ⅛-in. piece of toothpick stuck in a pinhole made in the side of the reel. The rod is a ⅛-in. piece of rattan or wire.

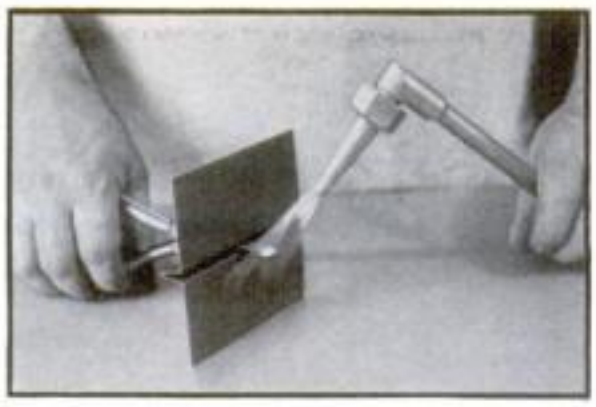
Sandpaper and assemble the parts. Fasten the fish to the flat edge of the base with a wire nail. Paint the fisherman's head and hands a buff color, cheeks rosy, lips red, and ears, eyes, and hair black. His shirt, trousers, and shoes are white trimmed with black. The fish is green trimmed with black, and the base is black.

The fish can be attached more securely to the base if the base is flattened slightly at that point. —CHARLES H. ALDER.



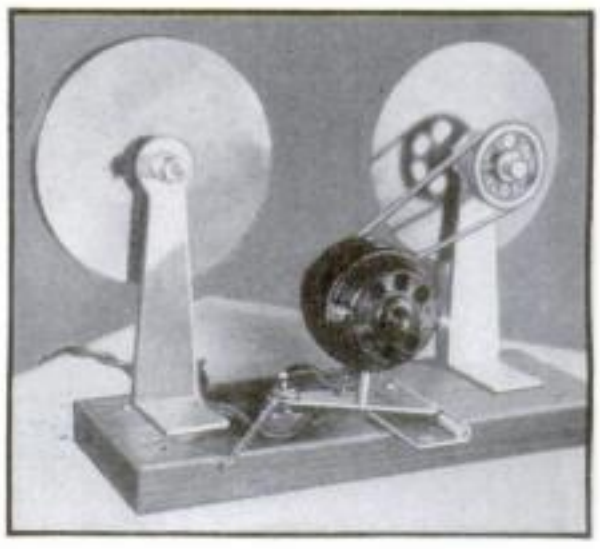
Patterns for the jig-sawed parts and sketch of the coconut. The base is a wooden disk about 4½ in. in diameter

The ash-tray parts ready to be assembled. The long upper dowel extends right through the coconut to hold it steady



HEAT SHIELD ON PLIERS PREVENTS BURNS

WHEN using a torch to heat up small pieces held in pliers, I use a shield to keep the flame away from my hand and to prevent the end of the pliers from becoming hot enough to draw the temper. This shield is just a square piece of sheet metal bent over double in the middle as shown so that the pliers grip both the shield and the work.—A. MOORE.

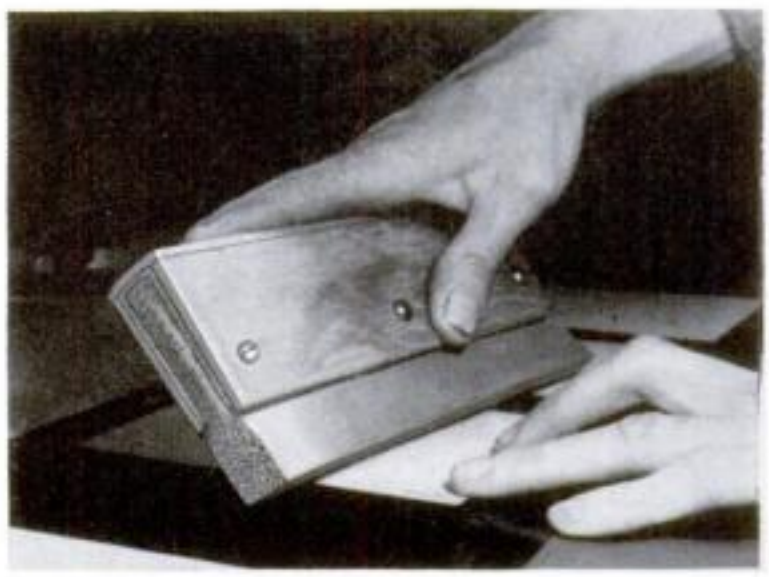


MOTOR RESTS ON HINGE

A SIMPLE, neat base for a small motor may be built from an ordinary T-hinge. In the case illustrated, a 4-in. hinge was used, the motor being mounted on the long leaf and the short one screwed to the baseboard. Two ¼-in. brass tubing uprights were used to raise the motor to the right height, and 6-32 machine screws were run through them into the motor casing. The end hole in the hinge was enlarged to accommodate the switch, which is of the toggle type used in radio sets, and a spring was added to give the tension necessary for keeping the belt tight.—PAUL H. NELSON.

SQUEEGEE OF SPONGE RUBBER

FOR ferrotyping photographic prints, many prefer a squeegee to a roller. The squeegee shown was made from a strip of sponge rubber, 3 by 8 in., cut from the edge of a kneeling pad and clamped between two pieces of plywood 2½ by 8 in. Kneeling pads are made of a rather dense sponge rubber, which is ideal for this purpose. The vulcanized edge of the strip should project about 1 in. as shown. Wood screws hold the rubber firmly between the strips. The handle is finished off by filling in the top edge with a square strip of wood.—DANIEL REYNOLDS.

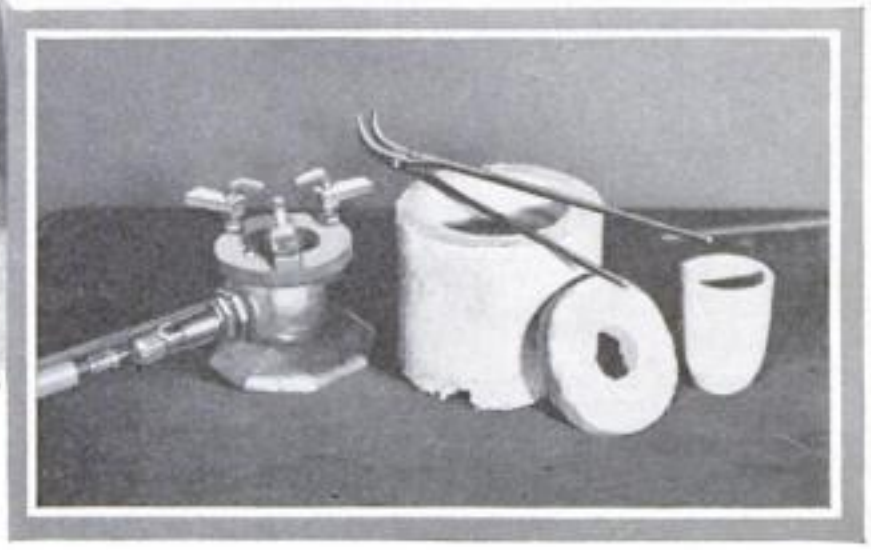


Ferrotyping a photographic print with a squeegee made by clamping sponge rubber between two strips of wood

Homemade Furnace Melts Aluminum

WITH ORDINARY ILLUMINATING GAS

By Donald R. Doremus



The burner, asbestos baffle, crucible, and cover are shown at the left. The body of the burner is an old 2 by 1¼ by 1¼ in. pipe tee. The gas and air enter through the side outlet

The mixture of gas and air is adjusted by means of a sliding sleeve on the inlet pipe

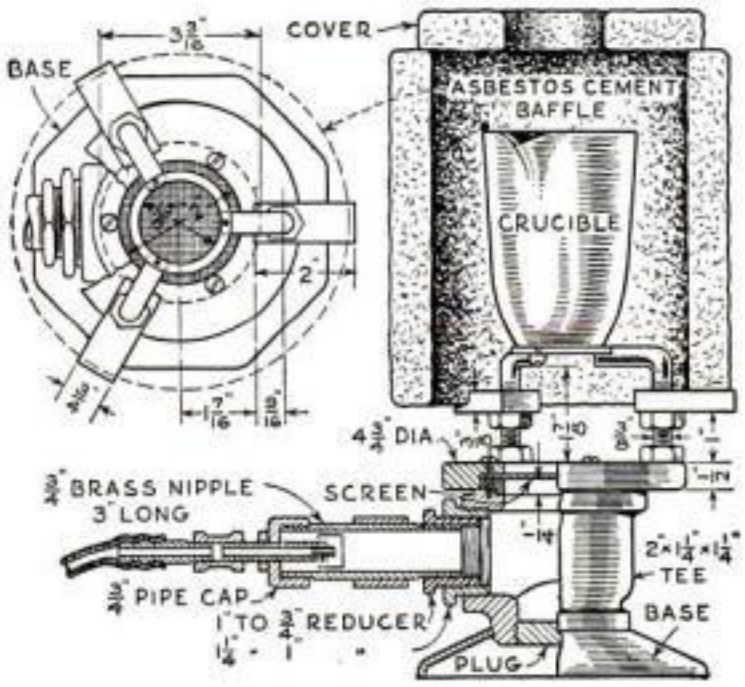
Castings for models and for such attractive novelties as this lamp are made with the aid of the furnace

The lamp ready for assembly. This project is a good example of what can be done with homemade castings

FURNACES for melting brass are often constructed by amateur mechanics with a vacuum-cleaner blower for the forced draft. I have such a furnace, but I use a paint-spray blower for the forced draft and get very good results. However, I have found that aluminum can be melted without a forced draft, and as aluminum will answer the purpose in most cases where castings are required by the amateur mechanic, I think my method will appeal to many who have hesitated to attempt making their own castings. The average amateur with a small lathe will find working with aluminum every bit as easy as brass.

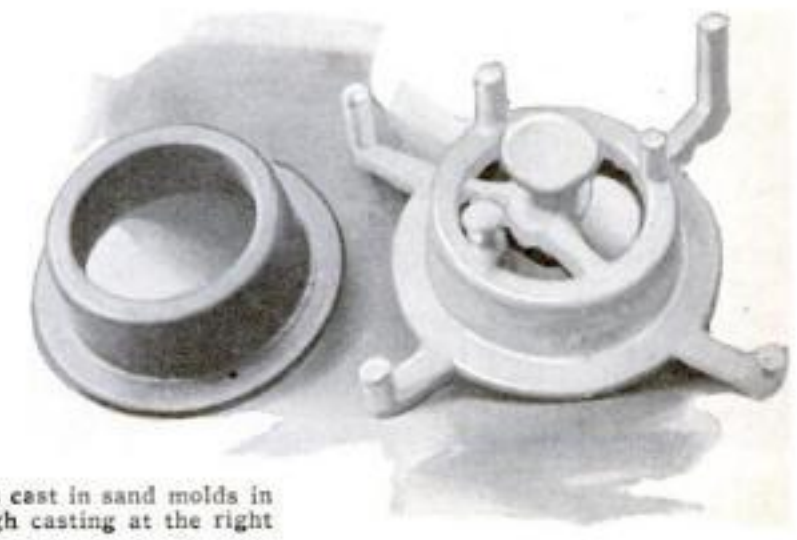
Brass requires 1,800 deg. F. to melt, while aluminum only requires 1,200 deg. The burner shown in the photographs melts aluminum with ordinary illuminating gas. It was made from an old 2 by 1¼ by 1¼ in. pipe tee. A pipe plug was screwed securely into the bottom and machined off. Then a shoulder was cut on the outside of that end of the tee and fitted into an opening in an old lamp base, which had been machined to match. The edge was peened over to hold it in place.

Reducing bushings were used in the side outlet to reduce it to ¾ in., and a piece of ¾-in. brass pipe, about 3 in. long, was *(Continued on page 97)*



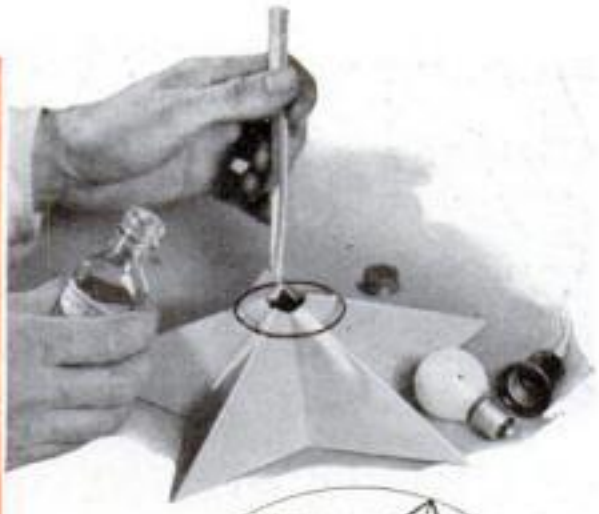
HOW MELTING FURNACE IS CONSTRUCTED

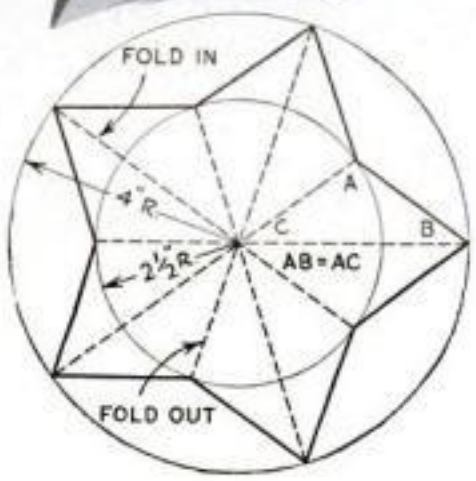
Working drawings of the furnace. Aluminum melted in it is cast in sand molds in which plenty of risers must be made, as shown by the rough casting at the right



New Ways to Light Your

Brilliant tinsel-covered star with a small intermediate screw-base lamp at its center. It may be used in a variety of ways





The star is cut out and folded as at the right, and a reënforcing ring is fastened to the back with celluloid cement as above

By

ROY ELTON

LIGHT, as produced by the electric lamp, affords perhaps the most striking and beautiful means of telling the world that you are in tune with the Christmas holiday season. To arrange an attractive decorative scheme with light is neither costly nor troublesome. George R. LaWall, a Cleveland illuminating engineer, has designed a number of new lighted novelties that can be built by anyone from cardboard and similar inexpensive materials. They employ lamps so small that the current consumed is negligible.

Most of these novelties are built around the S-11 Mazda lamp, obtainable in 6- and 10-watt sizes. This lamp has an intermediate screw base and a bulb diameter of 1⅜ in. The lamp is held in an intermediate screw socket of the pigtail type, with bakelite shell. Both lamp and socket can be obtained through electrical dealers, or from stores handling lighting equipment.

The "tinsel tree," one of the most striking decorations designed by Mr. LaWall, becomes a mass of glittering jewels when alight. The effect is the same front and back, so that it can be placed in a window or in front of a mirror indoors.

The base, which can be used also for other decorations of similar design, consists of two disks or squares arranged in pyramid fashion and surmounted by a cylindrical pillar that forms the stem of the tree. The tree part consists of a hollow isosceles triangle built up of cardboard segments, which are themselves triangular in cross section. The pieces are arranged to taper from the outer edges towards the center, so that light from the bulb in the center will fall on their surfaces. Small triangles of cardboard or cardboard frames covered with translucent colored paper serve as shields to cut off direct light from the lamp. The dimensions of the various parts are indicated on the accompanying sketches. You can use any type of glue to fasten the cardboard pieces together, but celluloid cement, such as builders of model airplanes employ, is particularly desirable because it dries rapidly.

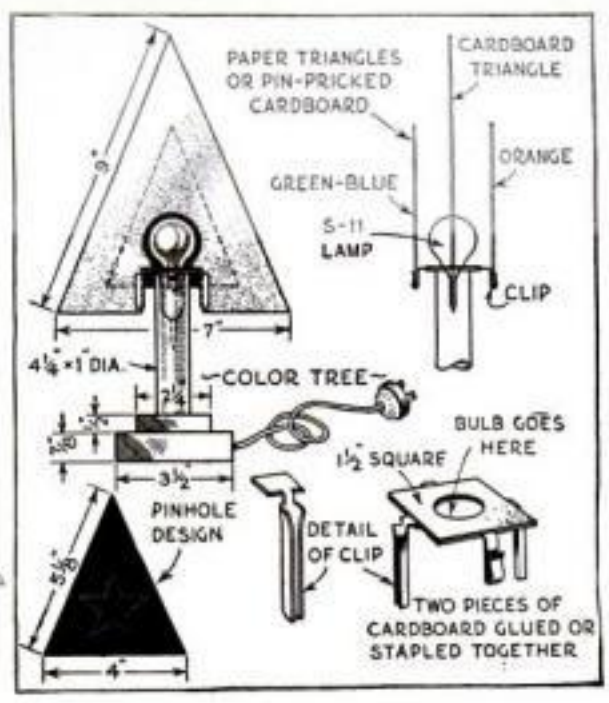
It is a bit of a trick to produce the triangle. When the three segments are laid out, cut part way through the cardboard with a sharp knife, along the lines where the material is to be folded. Fold with the scored side out. Before assembling the pieces permanently, test the bottom or lower segment to see that the lamp socket fits snugly in the openings cut for it.

The application of color and tinsel is done best before the base is fastened to the triangle. The base can be finished in a variety of ways and with water or oil colors, brushing lacquer, quick-drying enamel, or with colored paper glued on.

From a dealer in show-card artists' supplies you can purchase various kinds of tinsels or "flitter." These are metallic flake materials that reflect light. They are obtainable in various colors. For most purposes of Christmas decoration, the silvery tinsel, which is generally the least costly (about 35 cents for ¼ lb.) is satisfactory. The fine grade is preferable. Paint the front and back sloping surfaces

The small triangles are slipped into their clips at each side of the central triangle. *Below:* How the color tree is constructed

The illuminated color tree is beautiful to a degree no photo can show. *Below:* Clips of tin hold the cardboard sections in place



Home *for* Christmas

of the triangle with thin glue, such as white casein glue mixed with plenty of water, and sprinkle the tinsel liberally over the glue. When the adhesive has dried, remove excess tinsel by gently tapping the triangle edges with the fingers. These edges, incidentally, can be colored in any manner desired, as they do not reflect light from the bulb.

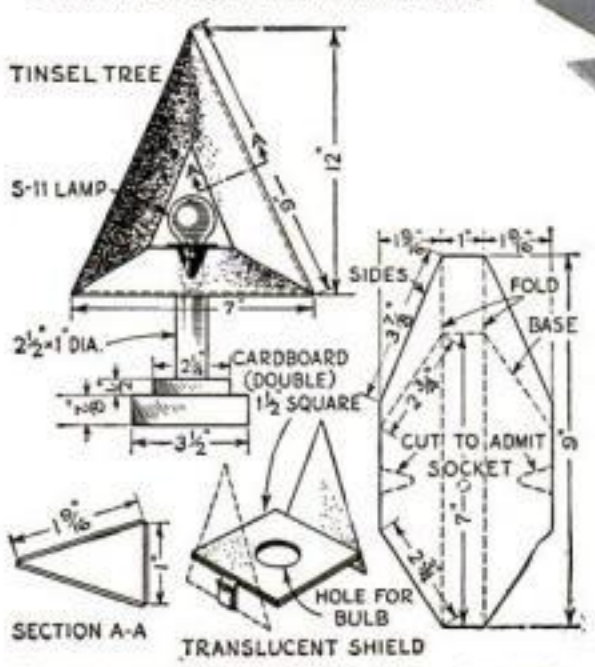
The "color tree" is simply a variation. Color one side of the central triangle red and the other green. The outer surface of one of the smaller triangles can be orange and that of the other silver. Tinsel of different colors is effective on the center triangle. In the smaller triangles, opposite the bulb, make a pinhole design—a star, reindeer, or other suitable form traced by punching holes through the cardboard with a needle.

The tinsel star is another decorative lighting novelty described by Mr. LaWall. It is particularly suitable for producing highlights in festoon decorations, and for window decoration. The star is made of heavy paper or thin cardboard, folded so that it is hollow on one side, and provided with a central hole that receives the base of an S-11 lamp. The hollow side of the star is covered with tinsel.

This masterpiece of lighting is a beautiful combination of effects anyone can duplicate

This glittering tree is suitable for a table, window, or mantel decoration. It is made almost entirely of cardboard and is lighted by a small lamp

Assembling the base and, below, inserting lamp in the center opening



How the ornament is made. Note that each leg of the triangle is itself triangular in cross section. *Right:* Sprinkling the tinsel

Even larger bulbs, such as the standard 25- or 40-watt size, can be employed to produce striking effects. For example, an interesting fixture for outside use can be made by mounting a socket in the center of a reflector having a matte surface, and equipping the bulb with a shield that is perforated with suitable designs. The reflector can be a 10-in. aluminum mixing bowl, the surface of which is given a matte finish by the application of a strong lye solution. A screw-ring porcelain socket is mounted in a hole in the center. The bulb is equipped with a shield cut from thin sheet metal (or even a cardboard medicine box of suitable size if the lamp is a small one). Tiny Christmas trees, flower petals, or other designs are cut in the shield and covered with one of the colored filter materials sold for use with store window lighting fixtures. The part of the shield covering the tip of the bulb and not entering into the reflected design can be fitted with a filter of a contrasting or harmonizing color.

A variation of this principle can be applied to wall surfaces, such as the outside of a building. Mount a socket in the center of the area, insert a 60- or 100-watt bulb, and place around it a shield of fireproof material, suitably perforated and equipped with heatproof color material. A satisfactory shield can be made from an empty coffee can and lid. Mount the socket on the inside of the lid, and punch the design in the *(Continued on page 113)*

Unique Perpetual Calendar

Changes Date When Flipped Over

By
P. G. LACKEY

TO CHANGE the date on this novel perpetual calendar, the pivoted box part is merely flipped over each morning so as to bring the rear surface towards the front. The new number then appears automatically in the window. This always interests and puzzles onlookers, although the mechanism is really quite simple—a series of seventeen blocks that slide up and down in a predetermined order.

Make the box first, preferably from a good cabinet wood. The windows may be left open or fitted with small glasses. If glass is used, be sure that the inside is flush or sunk a trifle. Assemble and glue the four sides with the windows at opposite ends. Leave the ends open.

For the blocks, make thin strips from a piece of white hardwood such as maple. Cut off nine very small pieces to see if their combined thicknesses will just fill the box. If so, cut seventeen blocks 1 by 1 7/16 in. and round all edges and corners.

The partition determines whether the calendar will work or not. Its ends, in the face view, fit tightly in the box. The edges, as shown in the side view, are beveled slightly and parallel to each other. The partition must be of such width that it allows enough space on each side between it and the box so that one block will pass through on each side at the same time. Glue or nail the piece in place, making sure it is accurately centered.

Try the number blocks to see if they slide correctly. Put eight pieces in one end of the box and nine in the other, as shown in the side view. Hold the ends of the box on and turn the box top toward you a half revolution. Do this about thirty times. If a block drops from the top in front of the window each time it turns over, you will know everything fits correctly. If the windows have been left open, draw a square the size of the window on each block as it drops down, and number these from 1 through 31. After 31 there will be three blank blocks. These may be left blank, pictures may be put on, or you may print the words "TURN SLOWLY" on them. The next number should be 1. If so, everything is correct. Remove the blocks from the box and paint on the numbers.

If the windows are covered with glass, you must number the blocks in the following order, a number on each side of the block. Invert the number on the backs, as shown.

1—18	13—30	25—8
3—20	15—Blank	27—10
5—22	17—Blank	29—12
7—24	19—2	31—14
9—26	21—4	Blank—16
11—28	23—6	

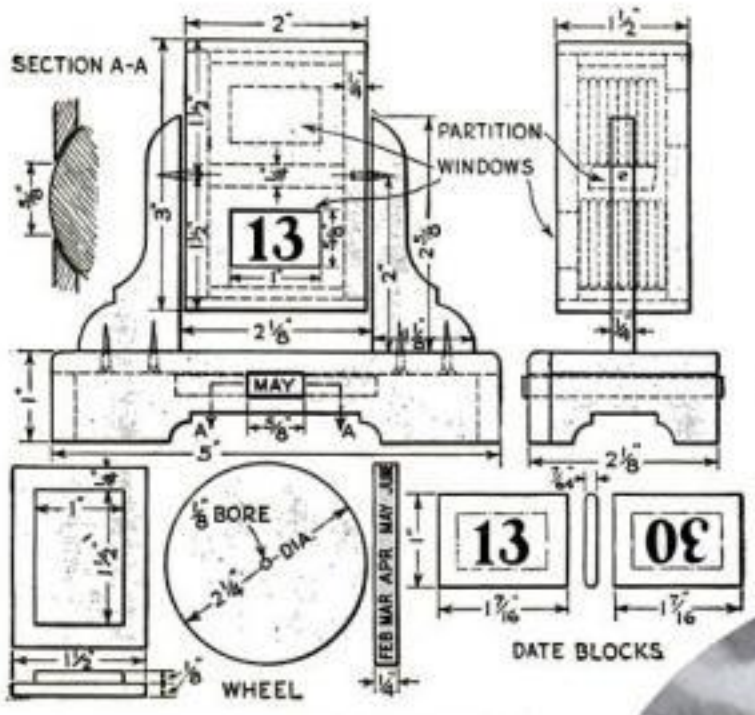
Now you are ready to place the blocks permanently in the box. Arrange them in the following order with number 1 on top: 1, blank (with 16 on the back), 31, 29, 27, 25, 23, 21, 19. This group goes in the bottom compartment with number 1 showing correctly in the window. Now put the lower end on temporarily. The order of the other group is as follows from the top down: blank (with 17 on the back), blank (with 15 on the back), 30, 28, 26, 24, 22, 20. Set these in the other end with the first blank showing in the window. Place the upper end on the compartment temporarily.

Now revolve the box, top end toward you. If the numbers appear at the windows correctly, the ends may be glued permanently. Be careful not to get any excess glue inside of the box, otherwise the blocks may stick.

The stand is made as illustrated. Cut an opening ¼ by ⅝ in. or longer in the front of the base for the names of the months to show through. Prepare a disk 2¼ in. in diameter from a piece of maple or other white hardwood ¼ in. in thickness, divide the edge into 12 sections, and paint on the names of the months. Fasten this in place with a small screw through the center of the disk.

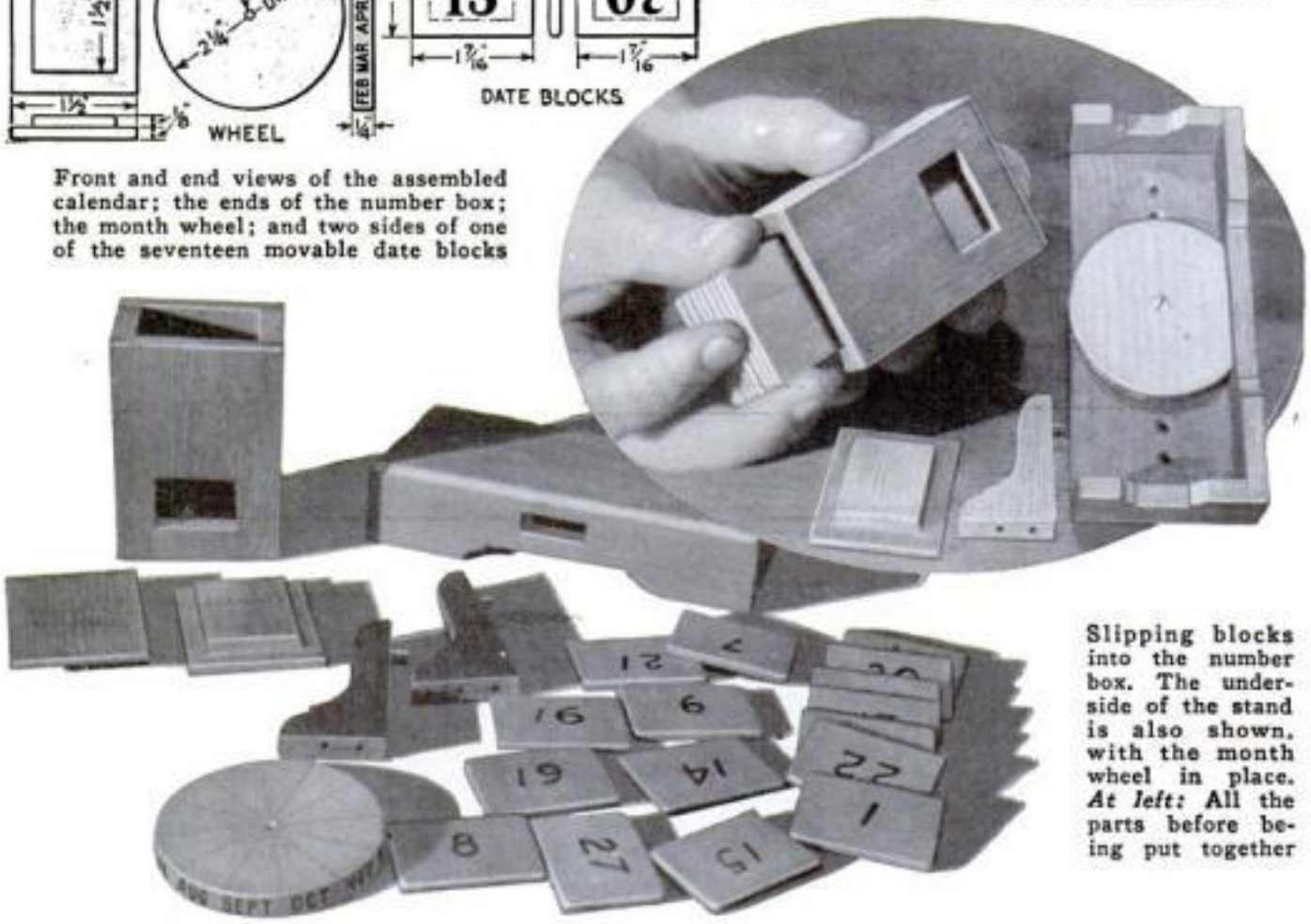
The pivots for the box are made from ½-in. screws with the heads ground to the same diameter as the shank. These are screwed into the upright supports 2 in. from the base and with 5/16 in. of the screw left showing. The box is now balanced and the pivot points marked. Bore small holes the size of the screw. Fasten one upright to the base, fit the box between the pivots, and fasten the other upright.

The calendar may be finished in any way you wish.



Front and end views of the assembled calendar; the ends of the number box; the month wheel; and two sides of one of the seventeen movable date blocks

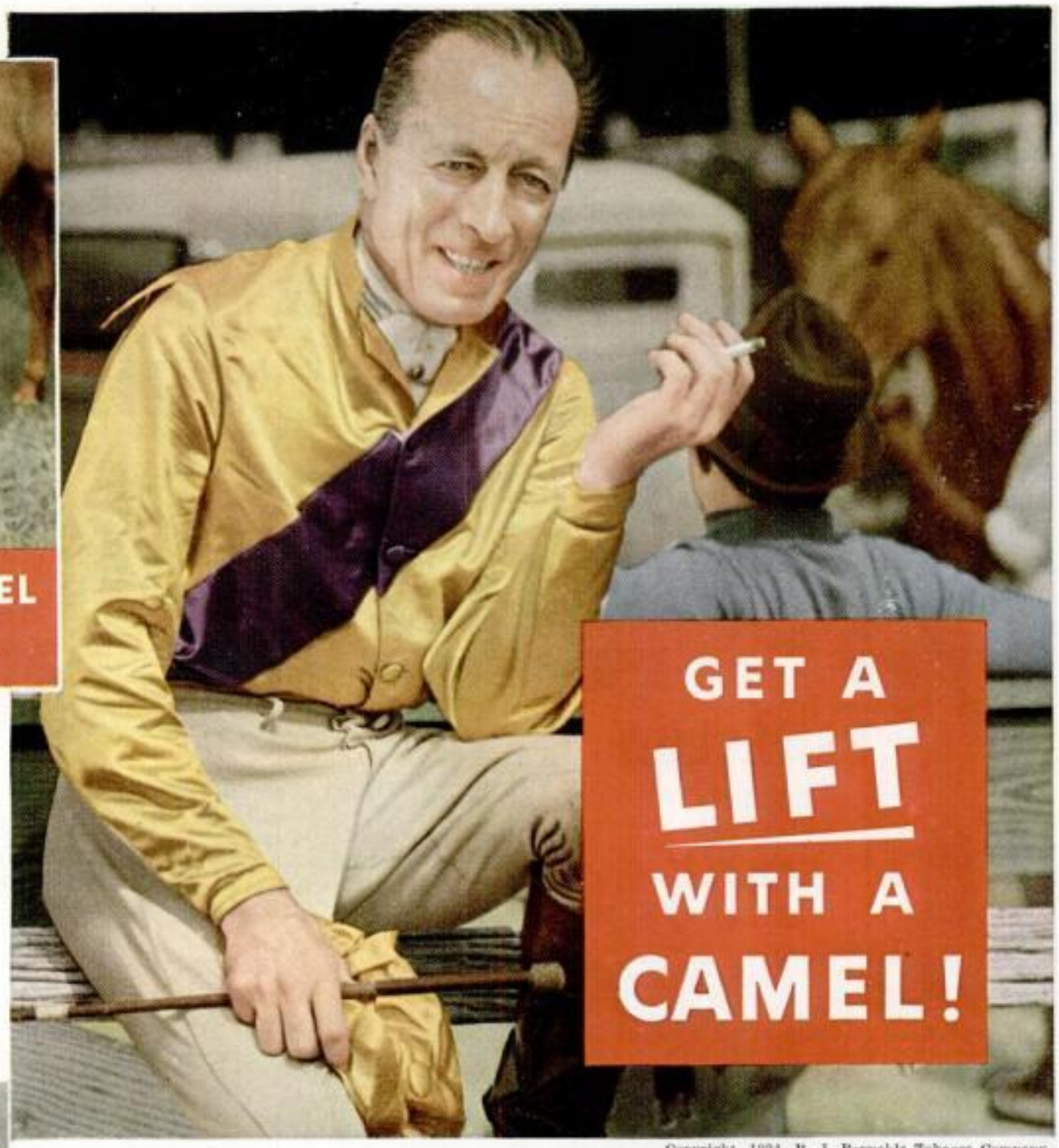
The next number comes in view automatically when the top of the date box is turned forward half a revolution. This is done by an ingenious system of sliding wooden blocks



Slipping blocks into the number box. The underside of the stand is also shown, with the month wheel in place. *At left:* All the parts before being put together

WHEN YOU FEEL "ALL IN"—

CRAWFORD BURTON, gentleman rider, twice winner of the Maryland Hunt Cup, dean of the strenuous sport of steeplechase riding ...a Camel smoker. Everyone is subject to strain. Hence the importance to people in every walk of life of what Mr. Burton says below about Camels.



GET A LIFT WITH A CAMEL!

MRS. CHARLES DALY, housewife, says: "Camels pick up my energy ...and have a mild, delicate flavor that a woman likes."

REX BEACH, famous sportsman, says: "When I've gotten a big game fish landed I light a Camel, and feel as good as new."

HAVE YOU TRIED THIS ENJOYABLE WAY OF HEIGHTENING ENERGY?

As this magazine goes to press, reports pour in from all parts of the country...showing that thousands of smokers are turning to Camels...and that they *do* "get a lift with a Camel."

Here's a typical experience. Mr. Crawford Burton, the famous American steeplechase rider, is speaking:

"Whether I'm tired from riding a hard race or from the pressure and tension of a crowded business day, I feel refreshed and restored just as soon as I get a chance to smoke a Camel. So I'm a pretty incessant smoker, not only because Camels give me a 'lift' in energy, but because they *taste so good!* And never yet have Camels upset my nerves."

You have heard the experience of others. Science tells us that Camel's "energizing effect" has been fully confirmed.

So try Camels yourself. You can smoke as many as you like. For Camels are made from finer, MORE EXPENSIVE TOBACCOS. They never taste flat...never get on your nerves.

ALL TOBACCO MEN KNOW: *"Camels are made from finer,* MORE EXPENSIVE TOBACCOS — *Turkish and Domestic — than any other popular brand."*

Camel's costlier Tobaccos never get on your Nerves

Remember last winter

This year, play safe with EVEREADY PRESTONE
THE GUARANTEED ANTI-FREEZE

From the standpoint of evaporation there are only two kinds of anti-freeze — those that boil away ("treated" or not "treated") and those that do not boil away. There is no middle ground. Eveready Prestone *does not boil away*. Don't confuse Eveready Prestone with any anti-freeze containing alcohol or glycerine.

A Specific Guarantee: National Carbon Company, Inc., specifically guarantees that Eveready Prestone, used according to directions, will protect the cooling system of your car against freezing and clogging from rust formations for a whole Winter; also that it will not boil away, will not cause any damage to car finish, or to the metal or rubber parts of the cooling system and that it will not leak out of a cooling system tight enough to hold water.

NATIONAL CARBON COMPANY, INC.
GENERAL OFFICES: New York, N. Y.
Unit of Union Carbide UCC *and Carbon Corporation*

SAME LOW PRICE!
$2.95
Per gallon

FIND YOUR CAR ON THIS CHART

IMPORTANT! The price per gallon of an anti-freeze means nothing unless you know *how many gallons* you will need during the winter. You can't get that information on a boil-away anti-freeze—you don't know how many gallons you will need. But you *can* get it for Eveready Prestone . . . and here it is. See how reasonably you can get two-way protection *all winter long* against both freeze-up and rust with *one shot* of Eveready Prestone—one shot because it won't boil off, no matter how warm the weather gets between the cold snaps. First cost is last cost—no trips back for more.

MODEL	10° above	Zero	20° below
	No. of Gallons		
Auburn			
6-80,'29; 6-85,'30; 6-52,'34	1	1½	2
8-100,'32; 8-101, 8-105,'33	1¼	1½	2¼
8-50,'34	1¼	1¾	2¼
Austin			
1930,'31,'32,'33,'34	½	¾	¾
Buick			
8-50,'31; 32-50,'32	¾	1	1½
34-40,'34	1	1¼	1½
60,'32; 50,'33; 50,'34	1	1¼	1¾
80, 90,'32; 60,'33; 60,'34	1½	1½	2¼
80, 90,'33; 90,'34	1½	2	2½
Cadillac			
341-B,'29; 355-A,'31; 370-C,'33	1½	2	2¼
370-A,'31; 355-C,'33; 452-B,'32	1¾	2¼	3
355-D,'34	1¼	1¾	2¼
370-D,'34	1¼	1½	2
Chevrolet			
'29; '30; Stand.'33; '34	¾	1	1¼
'31; '32	¾	1	1½
Master,'33; '34	¾	1	1½
Chrysler			
75,'29; 70,'30	1¼	1½	2
66,'30; 66,'31	1	1¼	1½
6,'31; '32; '33; '34	1	1¼	1¾
Royal 8; Imp. 8,'33	1½	1¾	2¼
8; Imp. 8,'34	1½	2	2½
Continental			
40, 60,'33; 41,'34	¾	1	1¼
De Soto			
6,'31; '32; 8, '31, '33	1	1¼	1¾
6,'34	1¼	1¾	2¼
Dodge			
6,'29; 6,'30; 8,'31	1	1¼	1¾
8,'32; 8,'33; 6,'34	1¼	1½	2¼
Essex-Terraplane			
'29,'30,'31,'32	1¼	1½	2¼
6,'33	¾	1	1½
8,'33	1	1¼	1¾
6,'34	1¼	1½	2
Ford			
A,'29,'30,'31; B,'32,'33	¾	1	1½
V-8,'32,'33,'34	1½	1¾	2½
Graham			
827, 837,'29; Cust. 8,'30	1¾	2¼	3
6, 8, Cust. 8,'34	1¼	1¾	2¼
Hudson			
8,'30; 8,'31,'32,'33	1	1½	2
8,'34	1½	2	2½
Hupmobile			
L8,'31; Cent. 8,'32; 417, 421,'34	1	1½	1¾
M'29; 222,'32; 422,'34	1½	1¾	2½
226,'32; 326,'33; 426,'34	1½	2	2½
La Salle			
345-B,'32; 345-C,'33	1¾	2¼	3
350,'34	1¼	1½	2¼
Lincoln			
8,'31,'32; 12-136, 145,'34	2	2½	3¼
Nash			
6,'29; 8,'32; 1070,'33; 1220,'34	1	1½	2
6,'30; 6-60,'31; 960,'32	¾	1	1½
8-80,'31; 980,'32; 1130,'33	1	1¼	1¾
1090, 1190,'33; 1290,'34	1½	1¾	2¼
8,'32; 1080, 1180,'33; 1280,'34	1¼	1¾	2¼
Oldsmobile			
F29-6,'29; F30-6,'30	1	1¼	1¼
L-33-8,'33; L-34-8,'34	1¼	1½	2¼
F34-6,'34	1	1¼	1¾
Packard			
633,'29; 726,'30; 826,'31	1¼	1¾	2¼
8v Sup 8,'33; '34	1¾	1¾	2¼
745,'30; 845,'31; DeL '32	1¾	2¼	3
Pierce-Arrow			
125, 126,'29; A, B, C,'30	1¾	2¼	3
41, 42, 43,'31; 54,'32	1¾	2¼	3
840-A,'34	1¾	2¼	3
836,'33	1½	2	2¼
Plymouth			
U,'29; '30; PF, PG,'34	1	1¼	1½
PA,'31; PB,'32	1	1¼	1¾
PC, PD,'33	1	1¼	1½
PE,'34	1	1¼	1¾
Pontiac			
'29,'30,'31; 6,'32	1	1¼	1½
V-8,'32	1½	2	2½
8,'33,'34	1	1¼	1¾
Reo			
Mate '29; 15, B-2,'30	1	1¼	1½
F.C. 6,'31; F.C. 6-21, 6-25,'32	1¼	1½	2¼
8-21, 8-25,'32; S-6,'34	1¼	1¾	2¼
Roy. N-2,'33; Roy. 8,'34	1½	2	2¼
Studebaker			
Com. 6, 8,'30	1	1¼	1¼
Dict. 8,'32; 6,'33	1	1¼	1½
6,'30; 6,'31	1	1¼	1½
Com. 8,'31 32,'33; Dict. 6,'34	1	1½	1¾
Pres. 8,'33; Com. 8, Pres. 8,'34	1¼	1½	2
Pres. 8,'29,'30,'31,'32	1¼	1¾	2¼
Willys			
77,'33	¾	¾	1
99,'33	¾	1	1½

IF YOUR CAR IS NOT ON THIS CHART, *see your dealer. Space here does not permit the listing of all cars but he has a chart showing the cost of Eveready Prestone all-winter protection against freezing and rust for all makes and models of cars, down to 60° below zero.*

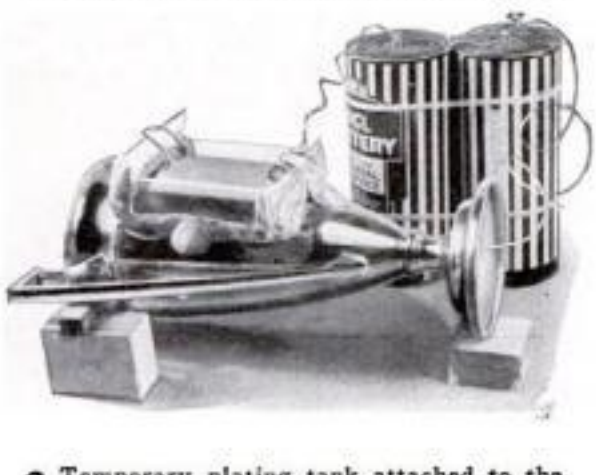
SEE PAGES 6, 98 AND 107

New Trophies *from* Old

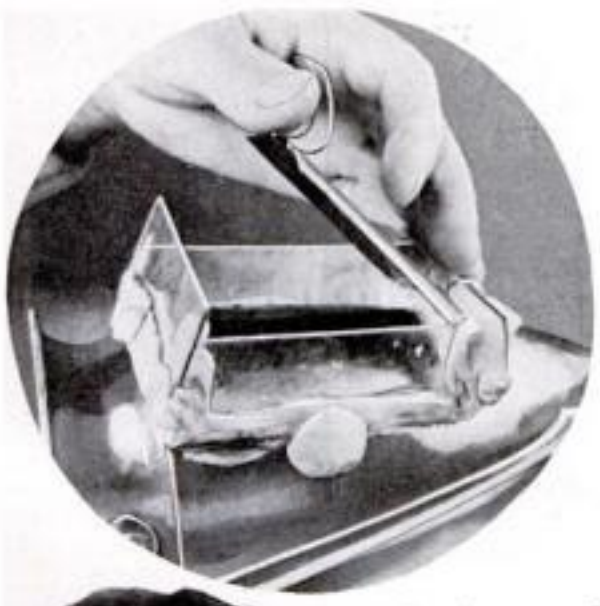
Ingenious method of electroplating fills up all unwanted engraving so that discarded silver cups and similar prizes may be used over again

By Kenneth Murray

1 Asphalt varnish is applied with a roller to the face, but it must not enter the lines



2 Temporary plating tank attached to the cup. The anode is a curved copper plate



3 A close-up of the tank and curved anode, which is connected to the positive pole

4 At intervals during plating, the anode is lifted to inspect progress

THOUSANDS of trophies and prize cups that are now gathering dust in schools, clubs, and on fireplace mantels can be made like new again by a simple electroplating method.

Clean the cup with lacquer thinner, cement—don't solder—any loose parts, and scrub the engraved lines with a ten percent solution of caustic potash, followed by a rinse and a quick brushing with a ten percent sulphuric acid solution. Coat the face of the cup with a thin film of asphalt varnish applied with an ink roller. See that none of the varnish enters the engraved lines, which are to be filled.

Four microscope slides and some putty can be formed into four walls that will hold the plating solution. Test it for leaks with water. Curve a sheet of clean copper to match the curve of the cup and suspend it, as shown, in the tank with a connection to the positive pole of the battery. Fasten a wire from the negative pole of the battery to the bottom of the cup. Two dry cells can be used for power, or you can use two cells of a storage battery with a small rheostat.

Any standard copper plating solution can be used, but a saturated solution of copper sulphate is easiest to prepare and safe to use. Pour enough into the tank to cover the anode. When close inspection shows the lines to be completely filled, which will take some time, break the connection and remove the solution and tank. Clean off the varnish and putty marks with gasoline.

5 The resilvering solution, which is poisonous but not especially dangerous, is applied by means of a cloth wrapped around a small stick

Silver cup before and after treatment. The new engraving is cut into the other, or untreated, side

By wrapping the end of a copper wire with cotton soaked in the plating solution and making the usual connections, you can retouch or blend the work in spots. Dry the surface and give it a light buffing with a polishing compound.

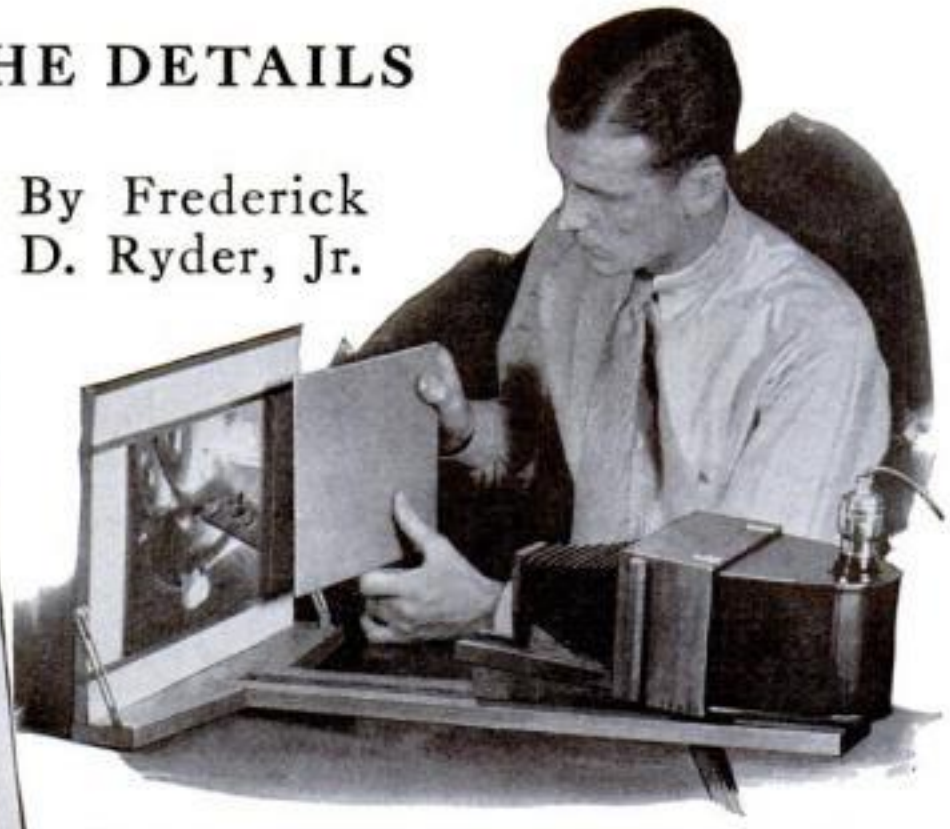
Resilvering of the cup may be accomplished by plating or with a silver compound that is merely rubbed on. The latter may be made as follows: In 1 oz. of distilled water dissolve, one at a time, silver nitrate, 25 grains; sodium hyposulphite (hypo), 40 grains; sal ammoniac, 25 grains. Give the face of the cup as much of this as it will take; rinse and dry, and then buff very lightly with jeweler's rouge. Apply a coat of thin lacquer immediately.

6 The final buffing and polishing with jeweler's rouge must be done very lightly and cautiously

How to Shade Your Photos

TO BRING OUT ALL THE DETAILS

By Frederick D. Ryder, Jr.



Enlargements and contact prints can be shaded by moving a black shield back and forth across them, beginning at the side that prints too dark. At left is a picture improved by this method

RIGHT over here—you can just make it out if you look close—is that new jig saw I was telling you about. You can see it clearly enough in the negative, but it doesn't show up much in this print."

An enthusiastic home workshop friend of mine was trying to explain, with the aid of a photograph he'd taken, how he had worked out a new and convenient arrangement of his machinery. Unfortunately, the photograph had been made by the light coming from one side of the room, and the jig saw, away off in one corner behind a tall cabinet, had been poorly lighted.

The obvious solution in this case would be to take the picture over again, using an additional light, but even without doing that, he could easily have made an acceptable print from the negative. Like thousands of other amateur photographers, he had no idea how much improvement can be made in the printing or enlarging of unsatisfactory negatives.

The human eye automatically compensates for extraordinary differences in illumination, whereas a photograph has a much more limited range. You can, for example, see reasonably clearly and in detail an object in a dark corner of the room and at the same time see the texture of the drapery hanging in the window, where it is bathed in the direct rays of the sun. In a normal photograph of such a subject, if you make a print light enough to show the details of the object in the dark corner, then the whole area around the window will be just so much blank white paper with no details at all. If, on the other hand, you make a print dark enough to bring out the window details, then the darker portions of the room will be represented by coal black areas in the print. The same effect is noticed in all sorts of outdoor pictures, wherever there is strong and uneven lighting.

In previous articles, I have discussed intensification of the negative and choice of different kinds of paper to bring out the picture to best advantage. (See P. S. M., Sept. '31, p. 83, Oct. '31, p. 78, and May '33, p. 76.) But changing the degree of contrast one way or the other all over the negative helps only a little when the difficulty lies in uneven lighting. What is required is to make a print or an enlargement in such a way that the sections which normally appear too black are held back, and the sections that appear too light are printed to a darker shade. *(Continued on page 86)*

$50 *in New Photo Contest*

HERE is another chance to win a prize for your skill in photography. Just send in one or more of the best pictures you have taken recently. It doesn't matter what size the prints are or what the subject matter happens to be. The prizes will be as follows:

FIRST PRIZE.....	$25	THIRD PRIZE.....	$5
SECOND PRIZE.....	15	FIVE PRIZES, $1 each.....	5

Mail your entry to the Photographic Department, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than January 2, 1935, and mark it "December Photo Contest." It is not necessary to send the films.

Write on the back of each print your name and address and what type of lighting was used—daylight, photoflash bulbs, photoflood lamps, or other artificial illumination. No prints will be returned unless a self-addressed, stamped envelope is inclosed. The contest is open to any *amateur* photographer except employees of POPULAR SCIENCE MONTHLY and their families. The developing and printing, of course, may be done by a professional. In case of ties, each tying contestant will be awarded the prize tied for.

Here's how to take snapshots like this AT NIGHT!

IT'S EASY TO MAKE THIS PICTURE

Use Kodak "SS" Film. Set your camera for 1/25 second — open lens diaphragm to *f*.6.3. Put 1 Mazda Photoflood bulb in lamp A—2 in lamp B. Distances as indicated.

Sight the subject, click the shutter—and you've made the picture. Photoflood bulbs cost 25¢ each—last for many pictures.

. . . with Eastman's new high-speed "SS" Film

● THINK how much more thrilling picture making becomes! Now you can take snapshots indoors—*at night!* All the "home life" scenes you could never get are at your finger tips—without special skill or elaborate equipment.

Use a camera with an *f*.6.3 (or faster) lens, loaded with Kodak Super Sensitive Panchromatic Film. This high-speed (extra sensitive) "SS" Film does the trick—it's three times as fast as ordinary film under artificial light.

For light, use two or three Mazda Photoflood bulbs. Just hold the camera in your hands as you would outdoors, set for 1/25 second, lens at *f*.6.3 opening, and click the shutter.

For indoor pictures at night with slower lens cameras (including box models) use Verichrome (or "SS") and a Photo*flash* bulb—see free folder—with camera set for "time" exposures.

FREE FOLDER . . . complete instructions on indoor night photography. Photo*flood* snapshots . . . Photo*flash* pictures . . . all are covered in this free folder. At your Kodak dealer's—or write for your copy today. Eastman Kodak Company, Rochester, New York.

KODAFLECTOR—Inexpensive, efficient . . . makes 2 Photoflood bulbs do the work of 9. Complete, with stand, reflectors and cord, $5.

KODAK "SS" — the lightning-fast film, with the green lightning flashes on the familiar yellow box—the film that indoors or out, in any light, improves picture quality.

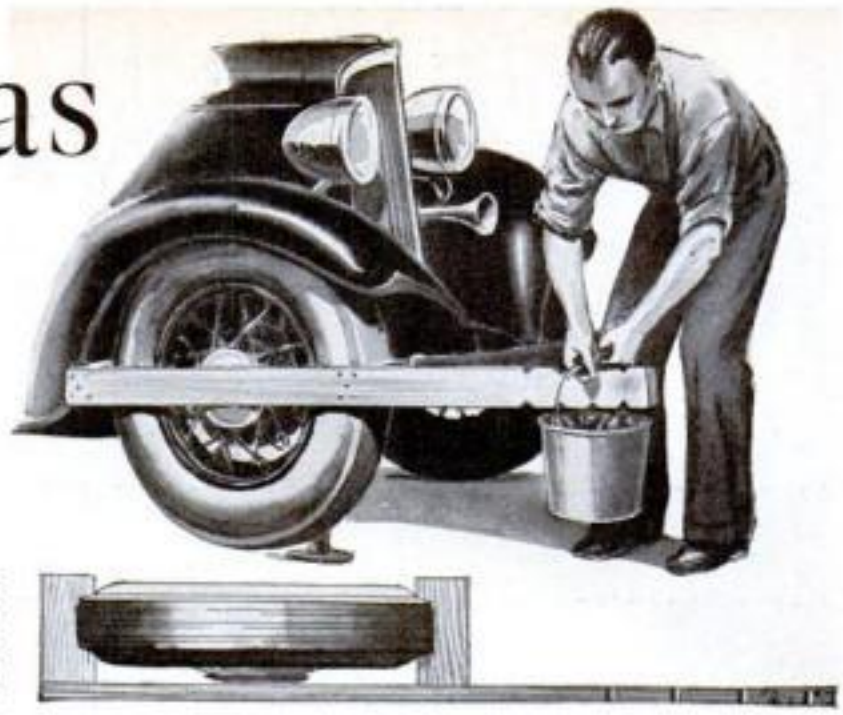
KODAK SIX-20 with Kodak Anastigmat lens *f*.6.3 is ideal for night snapshots. Pictures 2¼ x 3¼ inches, price $17.50. Kodak Six-16, with *f*.6.3 lens, pictures 2½ x 4¼ inches, $20.

IF IT ISN'T AN EASTMAN, IT ISN'T A KODAK

Ingenious Ideas

FOR CAR OWNERS

Our Readers Furnish New Suggestions For Handy Repairs and Improvements

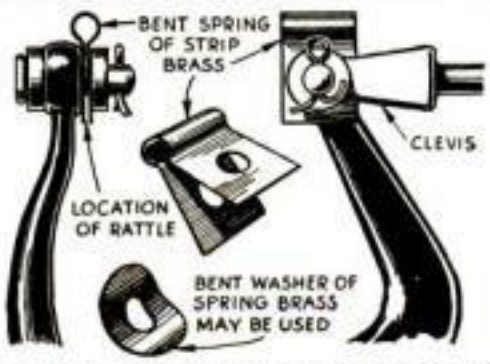


The apparatus illustrated at right, consisting of a notched rod and weighted pail, is used to gage brakes and equalize their pressure on wheels

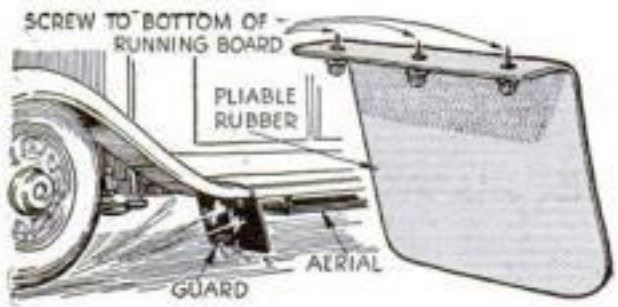
ORDINARILY, the job of equalizing brakes presents a difficult problem to the amateur mechanic and his meager supply of tools. However, by assembling the novel brake tester, shown in the illustration at upper right, anyone can obtain an accurate adjustment quickly and easily. The tester consists simply of a 1- by 3-in. board four feet long supplied at one end with two cupped blocks spaced and shaped to fit a tire and at the other with a series of notches or V-cuts. To this, a pail and some sand or stones are added to complete the equipment. To equalize a set of brakes, first wedge a broom handle or other piece of wood between the front seat and the brake pedal in such a way that the brakes are applied just enough to allow the loosest brake to slip slightly when an attempt is made to turn the wheel. Then jack up that wheel, tighten the brake adjusting bolt as much as possible, and slip the brake adjuster in place over the tire. Finally, hang the weighted pail in one of the notches and loosen the brake adjustment until the weighted lever barely turns the wheel. To bring the remaining brakes to the same adjustment, simply repeat the process with each wheel with the pail hung in the right notch. If you wish the rear brakes to grip before the front units, simply adjust the rear wheels with the weight in the end notch and set the front brakes with the weight hung in the second V-cut.—S. A. F.

Silencing Brake Rods With a Spring Clip

ALTHOUGH various types of clips and springs are used to silence brake rod clevis joints, most of them are designed to stop only one kind of rattle. A better and more universal clevis-joint silencer is the homemade spring clip shown in the illustration. Made from spring brass or a wide corset steel, it is placed between the outer washer and the brake link at the joint. Serving to spread the parts, it holds the assembly tight, yet does not interfere with the brake adjustment. A spring washer bent as shown also can be used.—D. J.

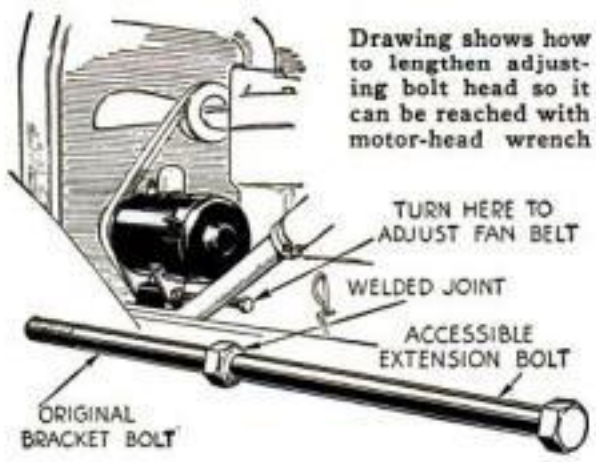


Homemade clip that silences brake rod joint



Rubber on Running Board Protects Radio Antenna

BY MOUNTING a square of rubber under the front edge of the running board, you can protect a running-board type of radio antenna from injury. It also will serve as a shield to prevent mud from being splashed up where it might coat the antenna and cause a possible short-circuit to the car body. Any piece of pliable sheet rubber can be used; rubber stair pads form an exceptionally good source of material.—D. W. P.



Drawing shows how to lengthen adjusting bolt head so it can be reached with motor-head wrench

Handy Bolt Extension Speeds Adjustment Work

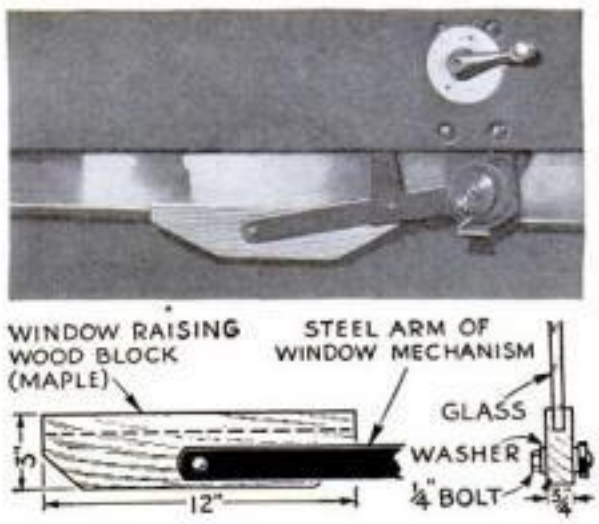
ON CARS where fan-belt tension is adjusted by moving the generator, it is often difficult to find a wrench that will both fit and reach the partly hidden bolt on the generator bracket. To get around this on my car, I had a one- and one-half-inch length of cylinder-head bolt welded to the top of the adjusting bolt head. This provides just the right amount of extension and makes it possible for me to use my cylinder-head wrench when making adjustments. Incidentally, this same kink can be applied to screws, bolts, and adjustments located in out-of-the-way places on any piece of machinery.—E. T. G., Jr.

Stopping Hood Rattles With Old Fan Belt

WHEN the rubber pads under hood fasteners wear, the hood rattles. A repair can be made with a section of old fan belt. Remove the worn rubber and insert a suitable length of old fan belt.—H. V. T.

How to Repair Metal Arm That Supports Window

IF YOU own a closed car and an opened window suddenly fails to respond when the crank is turned, it may be that the metal arm supporting the glass has rusted through. How the writer repaired this arm on his car is shown in the illustrations. First, a new supporting arm for the glass was fashioned from a piece of three-quarter-inch maple. Along the top edge, a one-quarter-inch groove was cut to take the bottom of the glass. Then the original stud at the end of the steel raising arm was punched out and a one-quarter-inch stove bolt substituted as a mounting for the new support, an iron washer being used on each side of the wood block and the end of the bolt being peened over to serve as a rivet. To make the glass slide easily, the groove in the support was coated with graphite.—H. P. S.

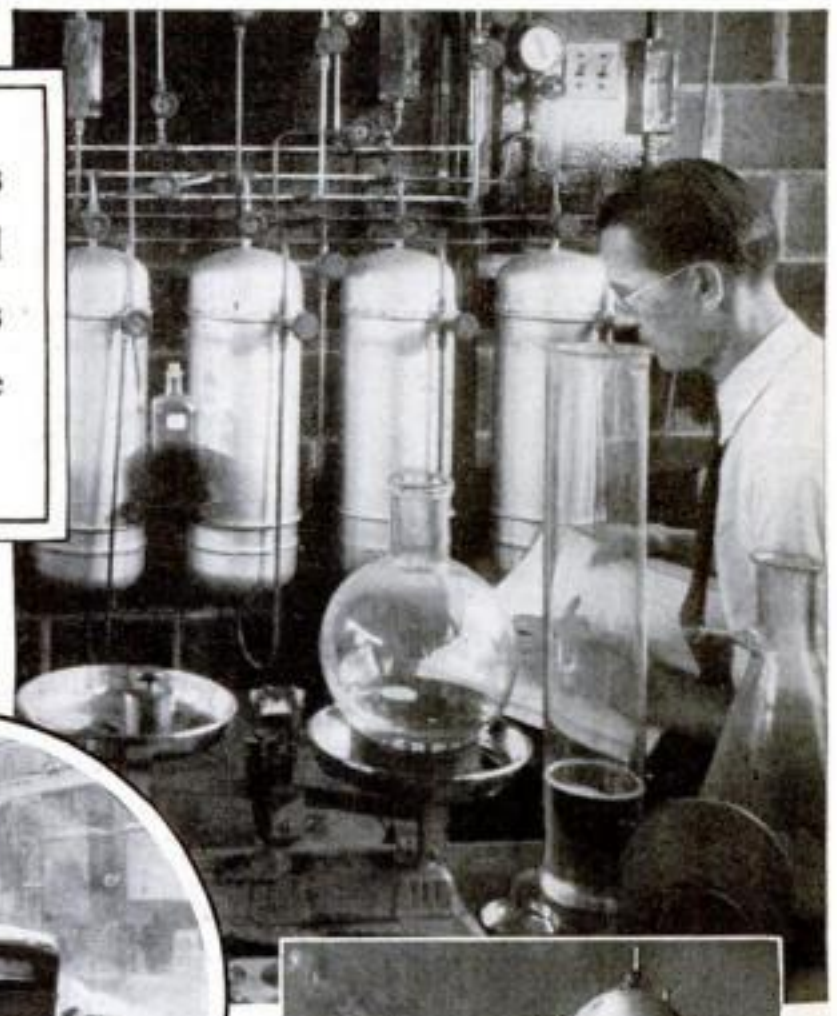


An easy way of repairing metal arm that supports a closed car window is shown above

Socony-Vacuum Announces
REVOLUTIONARY DISCOVERY IN OIL REFINING!

...that will save Millions of Dollars for Motorists this Winter

How the Socony-Vacuum Clearosol Process purges oil of impurities...why the new Mobiloil Arctic starts up to 50% easier . . . Lasts as much as 25% longer . . . Gives your Engine Complete Protection in Zero Weather



Miniature refinery where Socony-Vacuum worked on the Clearosol Process.

THIS WEEK Mobiloil dealers are selling a new kind of Mobiloil, made in an entirely different way called the Clearosol Process.

By actual test, this oil makes starting as much as 50% easier, lasts up to 25% longer, ends gum and sludge.

It flows quickly at low temperatures, and holds its body under extreme ranges of heat.

You may well ask, "How does all this happen?" The answer lies in a new approach to oil refining.

In the past, refiners tried to remove natural impurities from oil by acid baths and filters. Socony-Vacuum found a way to *wash away* these non-lubricating elements.

Our new process actually *dissolves* impurities—much as soap and water dissolve dirt! The oil that results is practically 100% pure lubricant. Such an oil is naturally worth more to you, but we haven't increased the price per quart by a single cent.

Now is the time to prepare your car for Winter driving. Drain off your Summer oil—and refill today with clean, fresh Mobiloil Arctic.

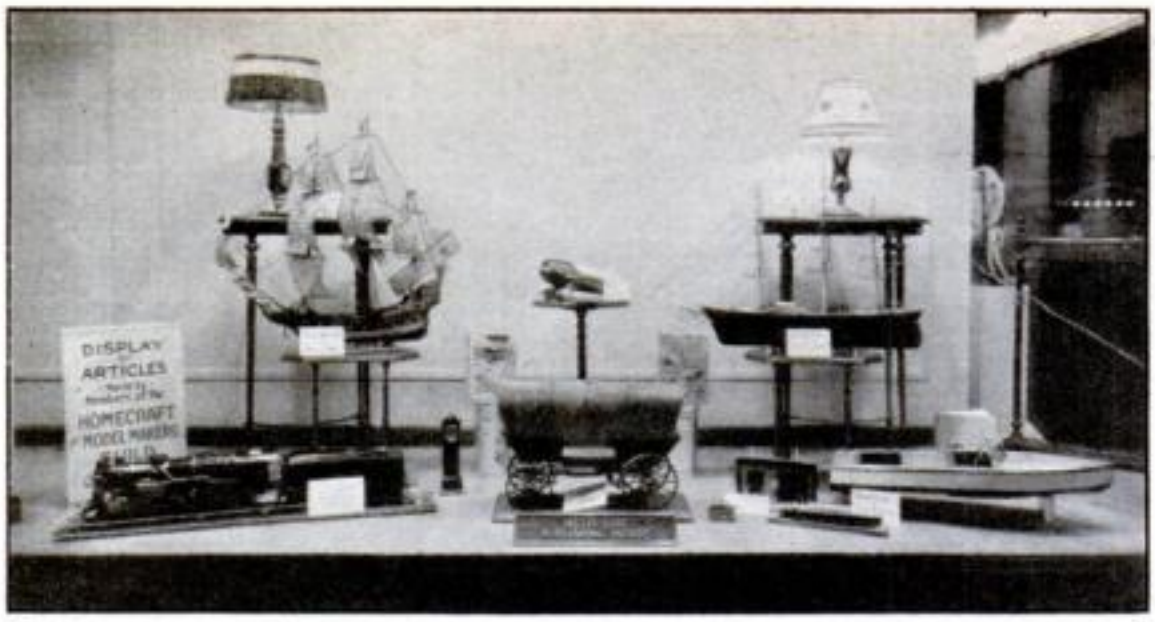
Just go to the nearest dealer who shows the Mobiloil sign with the red Gargoyle—or the familiar sign of the Flying Red Horse. Don't put off protecting your car. Act today! Socony-Vacuum Oil Company, Inc.

These huge tanks hold the materials that wash useless, non-lubricating sludge and gum from crude petroleum.

Mobiloil Arctic

SOCONY-VACUUM

MADE BY THE NEW SOCONY-VACUUM CLEAROSOL PROCESS



Home Workshop Clubs Plan Many Local Exhibitions

Sterling silver medal given by this magazine to a number of Guild clubs

Popular Science silver medals distributed as special prizes for craftwork . . . Activities of the Guild expand rapidly

•

MANY clubs affiliated with the National Homeworkshop Guild already have their plans in shape for holding a local exhibition before the end of the year. Practically all of the remaining clubs, it is expected, will put on a craftwork show of some type before next March, in order that their best exhibits may be released in time for the National Exhibition and Contest, which will be held late in March.

POPULAR SCIENCE MONTHLY is sending a beautiful sterling silver medal with the Guild insignia to each club of more than twenty members as a special craftwork prize to be awarded at its local exhibition. These medals are donated without cost to the clubs and are to be given for the best individual piece of work shown at each exhibition under the club's own rules and regulations.

The first application for a medal came from the rapidly growing and energetic Wood-Ridge Homeworkshop Club of Wood-Ridge, N. J., of which L. J. Messenger is president and George N. Schalk, secretary. Its application was rapidly followed by those of the Lexington Homecrafters of Lexington, Ky., the Bison Homeworkshop Guild of Buffalo, N. Y., the Homecraft and Modelmakers' Guild of Richmond, Va., the Topeka Homeworkshop Club of Topeka, Kans., the Fairfield Hobby Club of Fairfield, Ala., the Madison Homeworkshop Club of Madison, Wisc., the Eugene Craftsman Guild of Eugene, Ore., the Rockford Homecraft Club of Rockford, Ill., the Scranton Craftsman Society of Scranton, Pa., and others.

Two clubs have already held their exhibitions—the Topeka Club, which now has sixty-two members, in September, and the Eugene Craftsman Guild in October. The Bison Guild, Fairfield Club, and Scranton Society are scheduled to hold their shows in November.

The Topeka Club, with the great enthusiasm and coöperative effort it has displayed ever since it was organized, staged its exhibition before the Popular Science medals were ready, but fortunately the die had been made so that it was possible to strike off one medal and rush it off to *(Continued on page 88)*

Old Bill SAYS:

WHITE or red lead should be used on dowel pins for all ordinary purposes, but for accurate work it is better practice to use vaseline or mutton tallow.

• • •

Better use an extra bolt or two when bolting down a job. It is easier on the bolts, and the work is more secure.

• • •

So many mechanics confuse their "mikes" with a snap gage!

• • •

A high-speed lathe center will outwear ten made from carbon steel.

• • •

A lead ball weighing about eight pounds is a handy tool for tightening milling arbors and end mills and setting work firmly down on parallels in a shaper and milling machine vise.

• • •

Do not grip a drill in a three-jawed type of drill-press chuck at its very end or it will soon ruin the jaws. Extend the drill all the way up.

• • •

It's surprising how close a pair of dividers can be set with a magnifying glass.

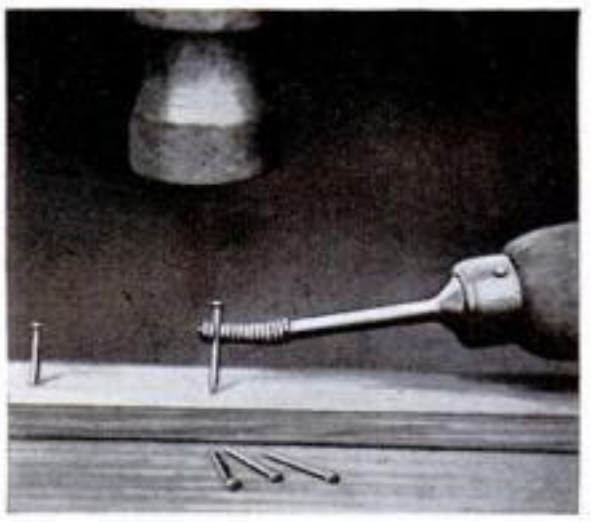
• • •

Welded jigs and fixtures should be heated to a temperature of 1,000 degrees Fahrenheit and allowed to cool in the air, thus normalizing them.

• • •

Where heavy lathe cuts are taken preparatory to grinding, the strain put on the centers sometimes wears them out of round. It is therefore good practice to recenter such work before it goes to the grinder.

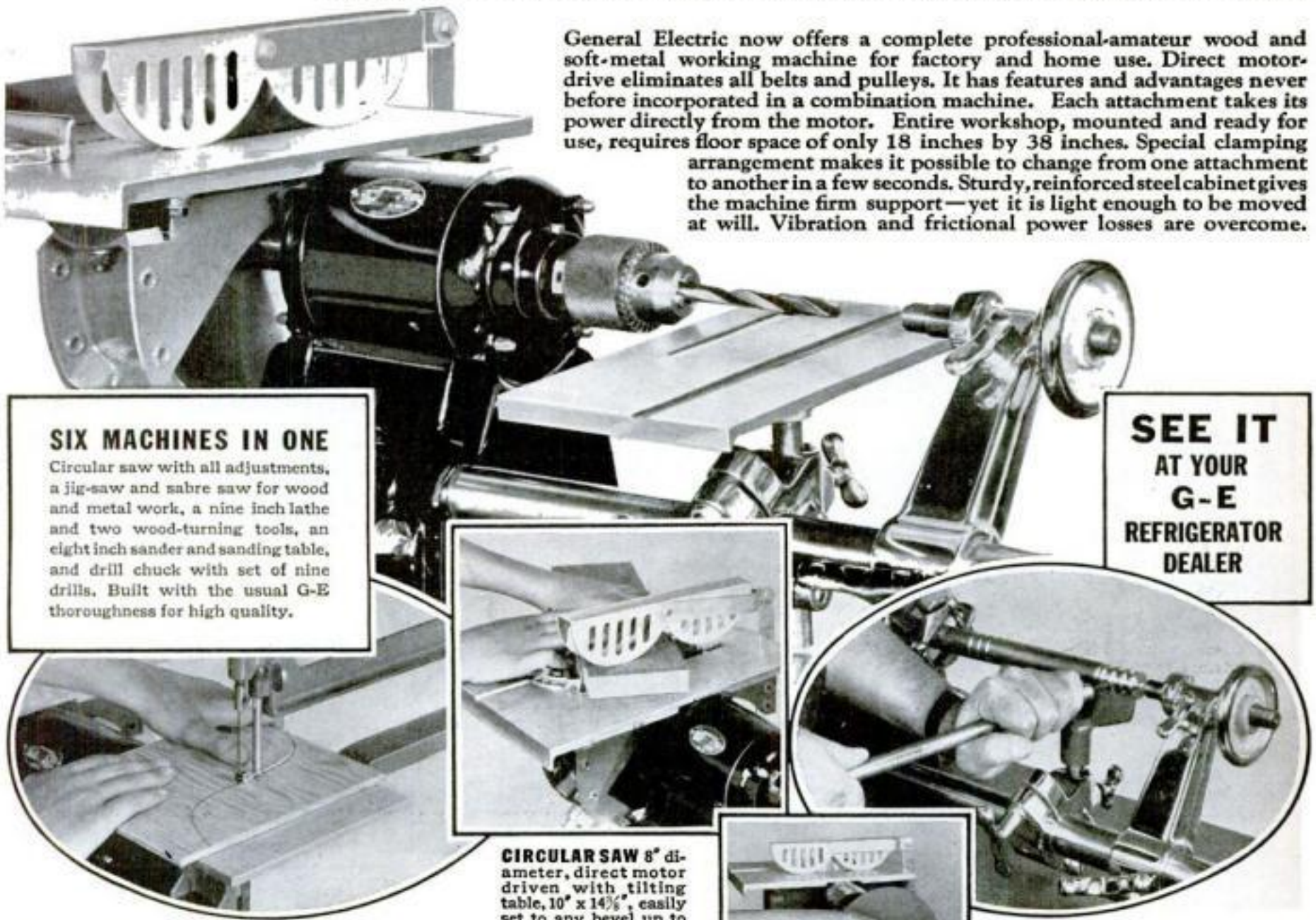
SPRING HOLDER AIDS IN DRIVING SMALL BRADS



SMALL nails and brads are difficult to hold when starting into the wood. A simple device not only to hold, but also to pick them up, is shown above. Force one end of an ordinary tire valve core spring on an awl or any other pointed tool. Pressing the free coils of the spring over the nails as they lie near the work picks them up in a convenient position for driving.—FRANK W. BENTLEY, JR.

NEW GENERAL ELECTRIC COMPLETE WORKSHOP!

See This Efficient, Sturdy, Direct-drive Quality Machine Demonstrated. Banishes All Belts and Pulleys. Complete with Motor, Bench, and Tools.



General Electric now offers a complete professional-amateur wood and soft-metal working machine for factory and home use. Direct motor-drive eliminates all belts and pulleys. It has features and advantages never before incorporated in a combination machine. Each attachment takes its power directly from the motor. Entire workshop, mounted and ready for use, requires floor space of only 18 inches by 38 inches. Special clamping arrangement makes it possible to change from one attachment to another in a few seconds. Sturdy, reinforced steel cabinet gives the machine firm support—yet it is light enough to be moved at will. Vibration and frictional power losses are overcome.

SIX MACHINES IN ONE

Circular saw with all adjustments, a jig-saw and sabre saw for wood and metal work, a nine inch lathe and two wood-turning tools, an eight inch sander and sanding table, and drill chuck with set of nine drills. Built with the usual G-E thoroughness for high quality.

SEE IT AT YOUR G-E REFRIGERATOR DEALER

COMBINATION SABRE AND JIG SAW, for wood or metal. Table Tilts 45°. Self-aligning overhead arm, needed only for fine saws and delicate work, quickly secured by single bolt. Saw chuck holds machine files with round shanks up to ¼-inch diameter, greatly increasing wide scope of machine. Sabre saw can be attached and in service in 6 seconds.

CIRCULAR SAW 8" diameter, direct motor driven with tilting table, 10" x 14⅜", easily set to any bevel up to 45°; adjustable protractor and mitre gauge, self-squaring rip guide, self-setting safety-guard.

LATHE swings work up to 9" diameter. Turning lengths up to 30" possible with bed extension. The face plate, fitted with removable cone or spur centers, screws directly on motor shaft, or is carried on special mandrel held chuck.

COMPLETE • COMPACT EFFICIENT!

There's Nothing Else to Buy

Motor, bench, drill, tools are all provided. G-E introduces this machine after years of research and development. Compact, high-efficiency ball-bearing motor has ¾" shaft reduced to ⅝" at the bearings. The powerful torque and inertia of the armature assure continuous flow of power at the cutting edge. Ideal for the home craftsman, professional woodworker, or small shop. Extraordinarily low power consumption makes it the most economical machine to operate that has ever been introduced. When you see its completeness—realize that there is nothing else to buy—the astonishingly low price will truly amaze you. Go now to your nearest G-E Refrigerator dealer and ask for a demonstration.

QUICK CHANGE ATTACHMENT CLAMP makes the attachment of the sanding table, sabre or jig-saw and tool post a matter of a few seconds. Construction is rigid and easily adjustable.

SANDER TABLE is grooved for the mitre gauge and rip guide of the saw and is slotted for a metal cutting saw or milling cutter. The 8 inch sanding disc screws directly on end of the motor shaft or is carried by arbor held in chuck.

FREE!

MAIL COUPON BELOW

for complete illustrated book on G-E WORK-SHOP

COMPLETE G-E WORKSHOP

Motor
Bench
Tools

$10.00 DOWN

Balance in Easy Payments

General Electric Company
Nela Park, Dept. PS 12
Cleveland, Ohio

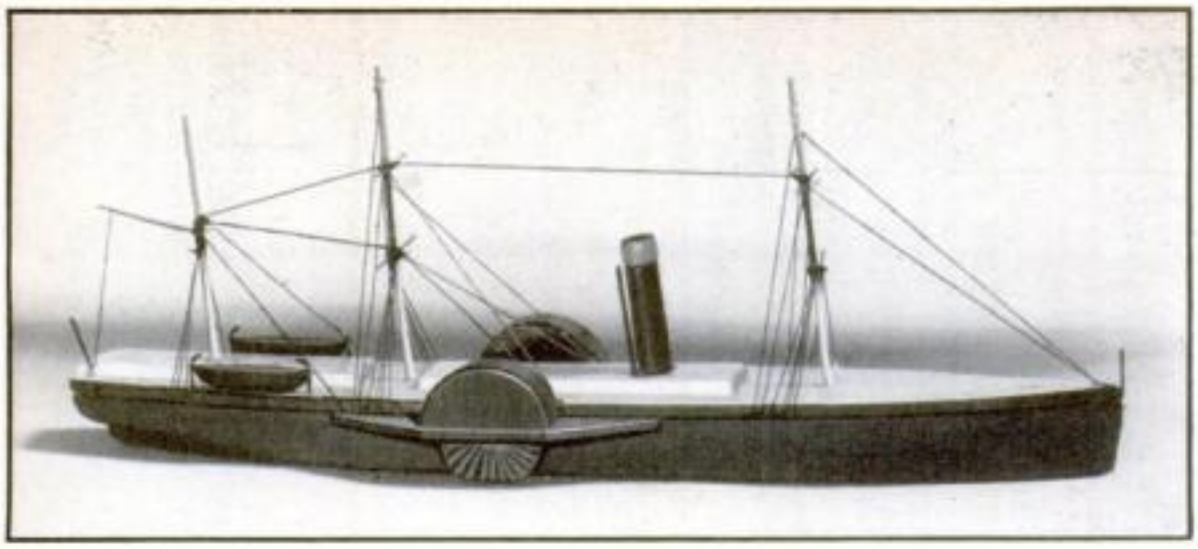
Please send me FREE your book describing complete G-E WORKSHOP.

*Name*_____

*Address*_____

*City*_____ *State*_____

GENERAL ELECTRIC



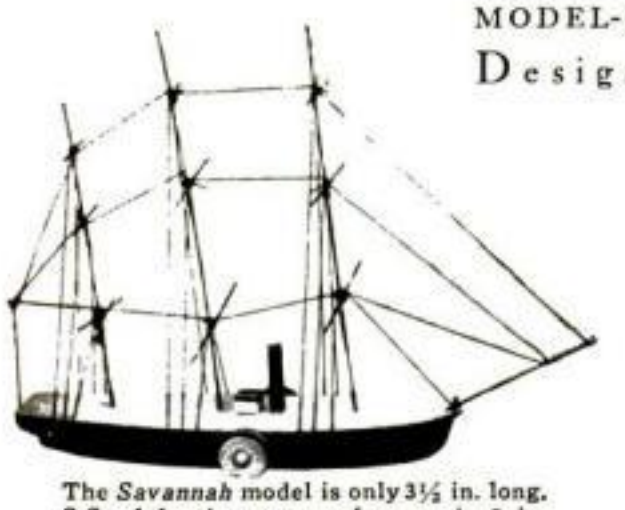
MINIATURE MODELS OF TWO FAMOUS

Old American Steamships

Savannah and *Atlantic*

MODEL-OF-THE-MONTH PROJECT No. 5

Designed by Theodore Gommi

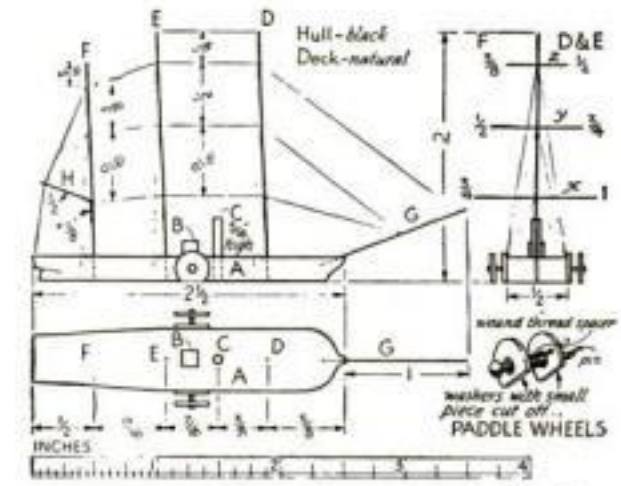


The *Savannah* model is only 3½ in. long. S.S. *Atlantic*, at top of page, is 6 in.

CONSTRUCTING decorative little models of two of the earliest and most famous American steamships is the next project in our Model-of-the-Month Club series. They are the *Savannah* and the *Atlantic*.

The *Savannah* was the first steamship to cross the Atlantic Ocean, which she did in 1819. Only 125 ft long and of 320 tons gross burden, she was unable to carry the coal needed for steaming the entire distance, consequently sails were used most of the time on her historic voyage. Eventually her machinery was removed and she spent her remaining days as a sailing vessel.

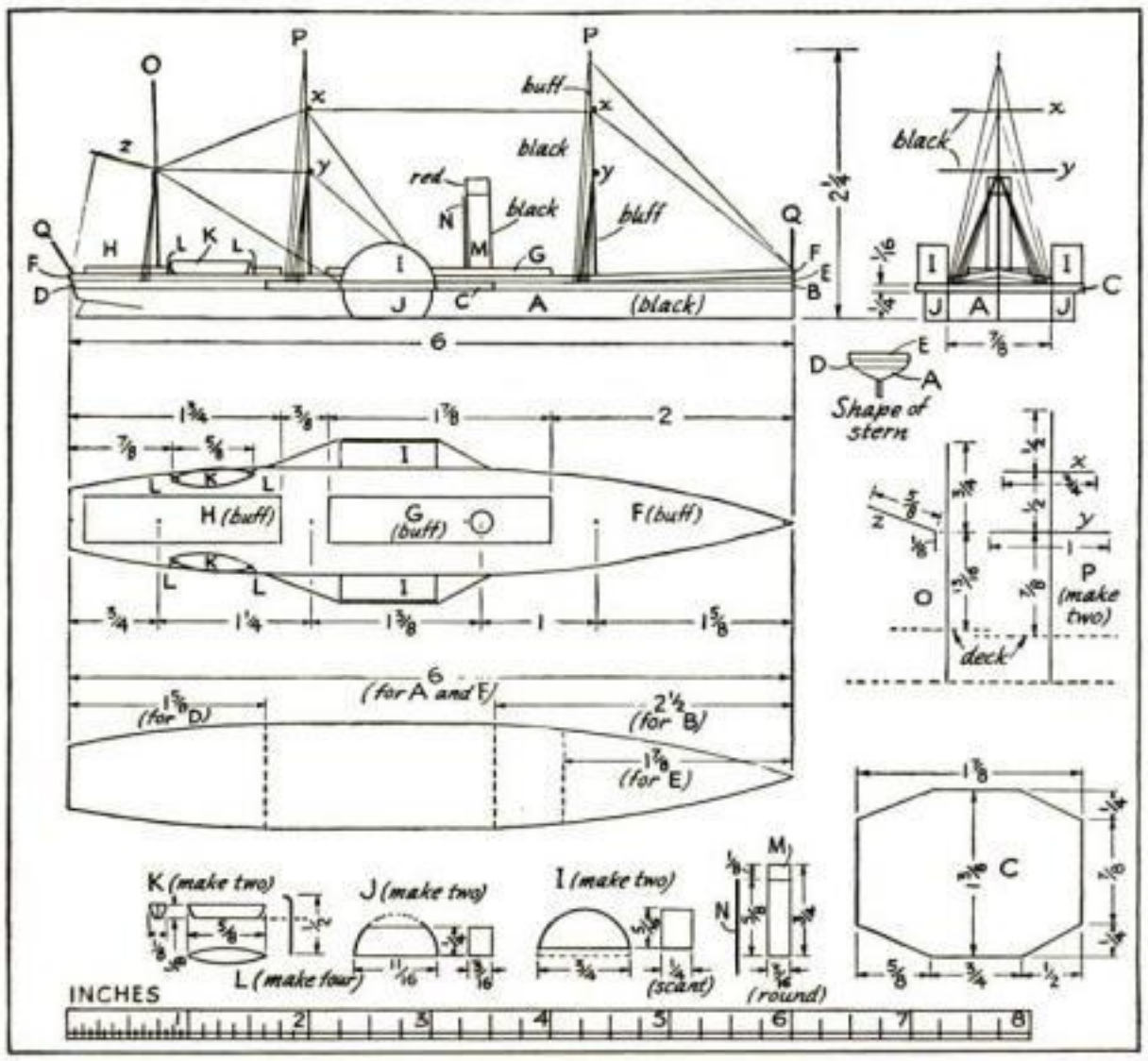
From time to time other vessels made voyages of a more or less experimental nature, but it was not until 1840 that the first regular ocean steamship service was established by the Cunard Line. Its success aroused American ship owners, and in 1848 the Collins Line was founded to wrest the traffic from the British. Four splendid ships, surpassing the Cunarders in every feature, were built. The first in service was the *Atlantic*, which made her maiden voyage in 1850. The Atlantic was



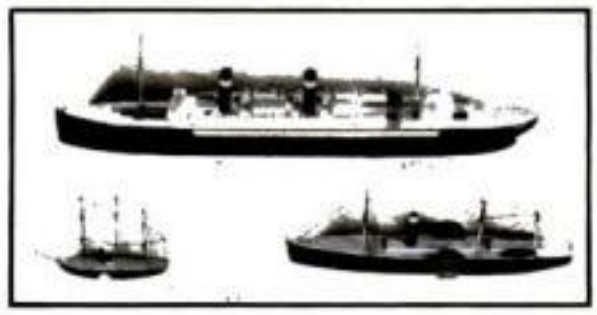
The *Savannah*. In the bow view, the lengths of the yards for masts *D* and *E* are given at the right, and the lengths for *F* at the left

300 ft. long and 45 ft. in beam, with a tonnage of 2,860. A unique innovation in her design was a straight stem, which has since been universally adopted in ship construction.

These two water-line models are made mainly of balsa wood and are on the same scale as previous models in this series of historic United States vessels—1 in. equals 50 ft. They therefore offer a remarkable comparison in the development of steam navigation. The great difference in their respective sizes gives



Three views of the assembled *Atlantic* model; a single pattern for laying out parts *A*, *B*, *D*, *E*, and *F*; a pattern for *C*; and details of the paddle wheels, masts, boats, and funnel



A striking comparison—the two early ships alongside the *St. Louis*, built to same scale

a clear idea of how much the steamship had to be improved before it passed from the experimental to the practical stage.

The accompanying drawings show the general construction and dimensions. In the *Atlantic*, part *A* is ¼ in. thick, parts *B* to *H* are 1/16 in. thick, and the smaller fittings are as detailed. In the *Savannah*, part *A* is 3/16 by ½ by 2½, part *B* is ⅛ by ⅛ by ⅛ in., part *C* is 1/16 in. in diameter and ½ in. long, masts *D* and *E* are 2 in. long, and *F* is 1¾ in. long.

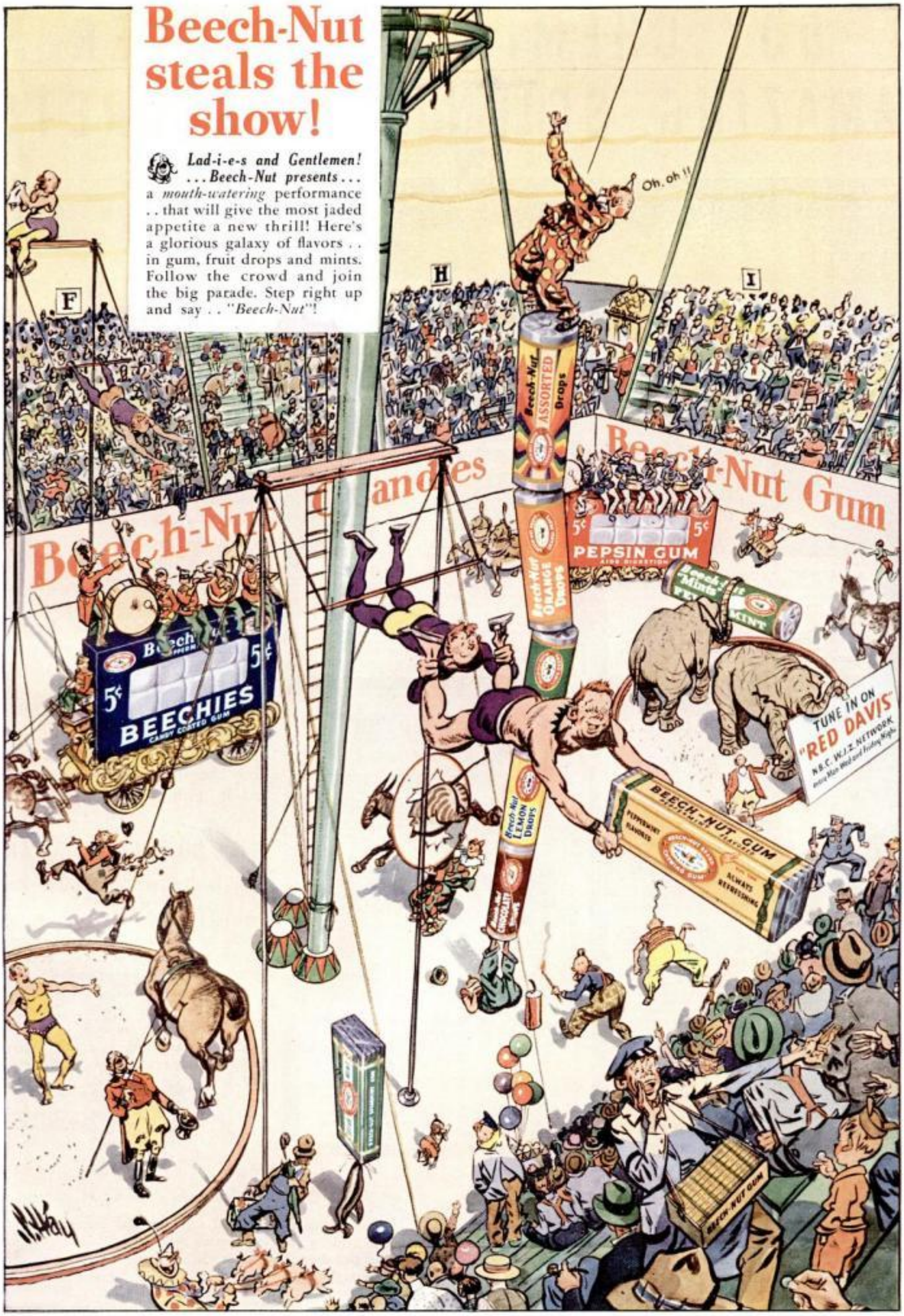
A complete construction kit for making both models may be obtained for 75 cents, postpaid (see page 10). This includes the necessary balsa wood and other materials, the paints, a full-size blueprint, detailed instructions, and itemized lists of materials giving the exact size of all parts. Although the kits have been designed especially for our Model-of-the-Month Club, other readers can obtain them, while the supply lasts, for the same price.

The full-size blueprint, detailed instructions, and lists of materials are also available separately for 25 cents. Order Blueprint No. 235.

Registered members of the Model-of-the-Month Club may obtain the instructions and lists free upon application by sending a self-addressed, stamped envelope.

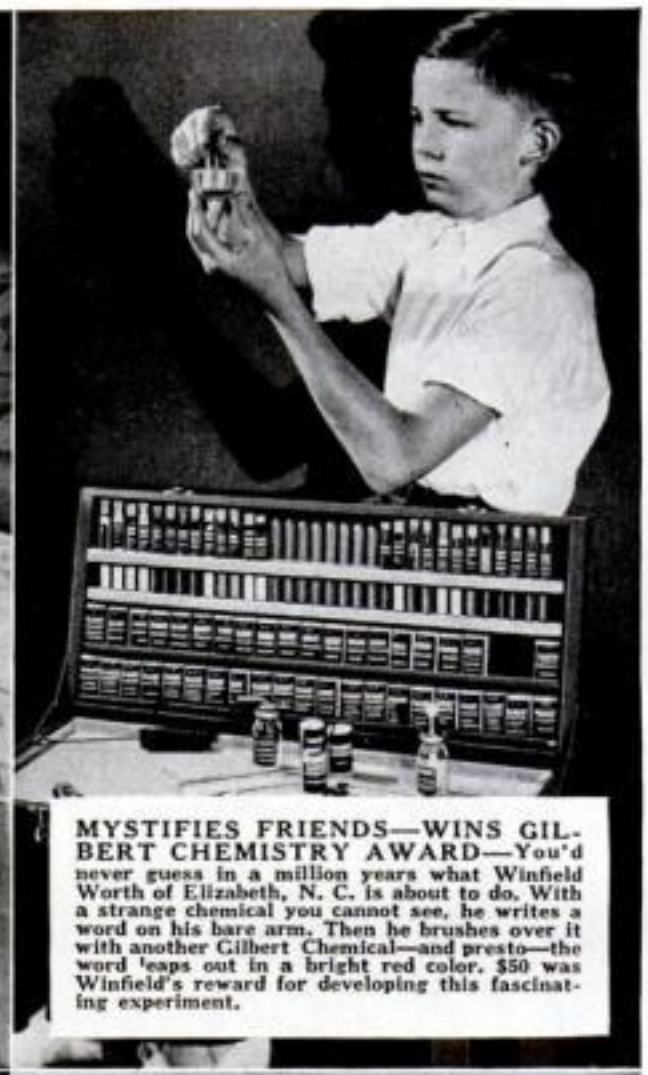
Beech-Nut steals the show!

Lad-i-e-s and Gentlemen! . . . Beech-Nut presents . . . a *mouth-watering* performance . . that will give the most jaded appetite a new thrill! Here's a glorious galaxy of flavors . . in gum, fruit drops and mints. Follow the crowd and join the big parade. Step right up and say . . "*Beech-Nut*"!



BOY CHEMISTS DISCOVER AMAZING SCIENTIFIC SECRETS

ORIGINAL EXPERIMENT BRINGS JACK CARTER $50—Can you think of anything more exciting than discovering how to change water into wine—dye cloth—make a chemical barometer that forecasts the weather? Best of all, develop your own original experiments! That is what Jack Carter of New York City did with his Gilbert Chemistry Outfit. For his important research, Jack won a Gilbert Chemistry Award of $50.00.



MYSTIFIES FRIENDS—WINS GILBERT CHEMISTRY AWARD—You'd never guess in a million years what Winfield Worth of Elizabeth, N. C. is about to do. With a strange chemical you cannot see, he writes a word on his bare arm. Then he brushes over it with another Gilbert Chemical—and presto—the word leaps out in a bright red color. $50 was Winfield's reward for developing this fascinating experiment.

SEE HIDDEN SCIENTIFIC WONDERS WITH THE NEW GILBERT MICROSCOPE—Imagine seeing a fly's foot so that it looks as large as a cat's paw—salt crystals so big they appear like lumps of ice—and thousands of other wonders of Nature and science. The powerful Gilbert Microscope makes Chemistry more thrilling than ever. Packed with Gilbert Micro Chemistry Sets No. 4 and No. 7 or it can be purchased separately.

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WOULDN'T you like to perform thrilling experiments such as Jack and Winfield and thousands of other boys are doing? Have a chemical laboratory of your own! Make chemicals change color — transform liquids into sparkling crystals — and explore countless other mysteries of the chemical world. You might win one of the cash awards Mr. Gilbert gives each year to the boys making the most important contribution to chemical research.

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HORSE'S HOOF AND SHOE FORM NOVEL INKWELL

To MAKE profitable use of his spare time, a blacksmith carves novel inkstands from black walnut as shown above. The hoof is fashioned carefully by hand and bored to hold the ink bottle. A shoe is made of wood and fitted under the hoof with wooden pegs in place of regular horseshoe nails. The inkwell cover is turned on a lathe.

Another shoe with round pegs placed in the nail holes is fastened to the back of the hoof and serves as a pen and pencil holder.—ARTHUR W. MOREAU.

HOW TO MIX A SOOTHING LOTION FOR THE HANDS

AN EXCELLENT hand lotion for use after working in your shop, may be prepared from glycerine, rubbing alcohol, and ½ dram (about 2 grams) of gum tragacanth. Place the gum in a mortar or a wide-mouth bottle and add 1 oz. of rubbing alcohol and 1 oz. of glycerine. Allow the gum, which is hornlike in character, to soak for several days. Rub and pound it with the pestle if a mortar is used, or with a hard stick if only a bottle is available. The gum will swell and become mixed. Now add 1 oz. of water and let stand, with a stirring once in a while, for another day. Next add 2 oz. each of glycerine and rubbing alcohol and about 7 oz. of water. A perfume may be mixed in, if desired, before adding the last water.

HOW TO SHADE YOUR PHOTOS

(Continued from page 78)

The problem is simple where the lighting shades off approximately uniformly. A picture of a room where all the light comes from the windows along one side, or from one artificial light placed at one side, is a good example. There are two ways to do the shading.

The first method is to move a cardboard or black paper shield back and forth across the negative in the printing frame or across in front of the paper on the enlarging easel as illustrated at the beginning of this article. The shield should be started across from the side of the picture that prints too dark. It should be moved steadily and fairly rapidly across to the other edge of the negative or print and then back again. Repeat this motion during the whole period you have alloted to shading.

The best practice is to do the shading only during some definite portion of the total exposure. Try one half, and then increase or decrease the percentage if the print needs more correction or less. It often happens that only the objects at one end of the picture need shading. In such cases, the shielding card is only moved across the portion of the print that needs treatment.

A test picture is shown that was purposely taken with all the light coming from one side. Immediately below it a much better print is illustrated. It was made by holding back the left end by the method described.

Partial shielding in this way often makes it possible to bring out the clouds in outdoor pictures. If they show up quite strongly in the negative when you hold it up to the light, you can cut a mask roughly shaped to hold back everything but the sky area. Instead of moving it across the picture area, give the normal exposure first, then hold the mask so as to hold back everything but the sky and move it in a small circle while you give an extra exposure from one quarter to one half as long as the first one.

The second way to get graded shading across the whole of the negative is to use shaded screens between the negative and the light source in either printing or enlarging. Such screens are easily made. Set up your camera facing a blank white wall or, better still, a large sheet of clean white paper. Focus on the wall or the paper and then deliberately throw the lens out of focus enough so that the grain of the paper or the texture of the wall completely disappears. Next place a photoflood lamp without a reflector off to one side so that the light on the wall is evenly graded from bright on one side of the picture area to not so bright on the other side.

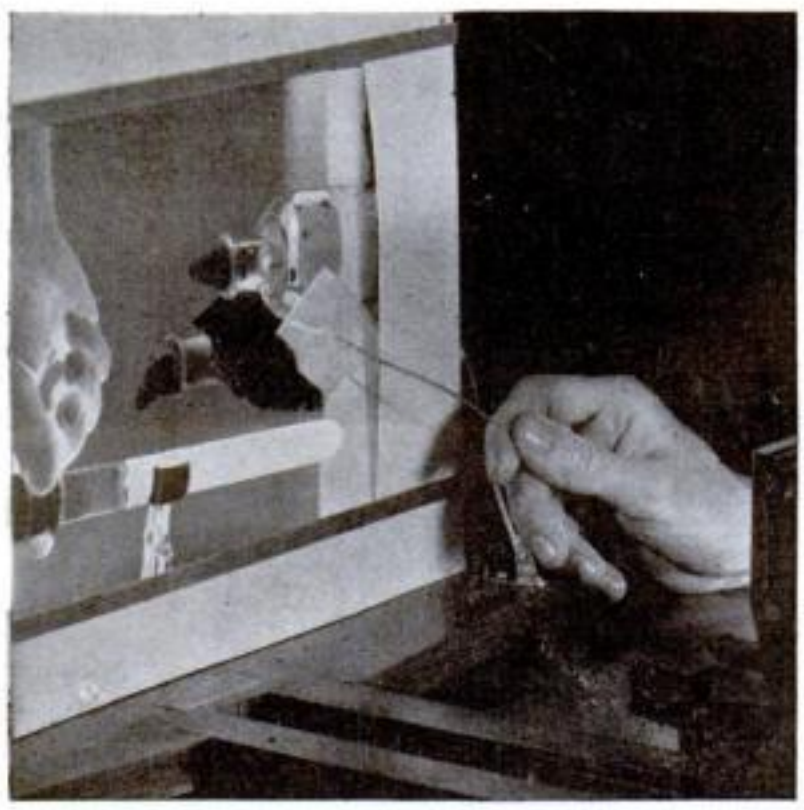
Shading can also be done with the aid of films tnat are graded from light to dark

Operate the shutter, giving about one twentieth of the exposure you would normally give for a room under such light. Several exposures should be made with different degrees of contrast in the brightness of one end of the picture area as compared with the other. If you also wish shields graded crosswise instead of lengthwise, make two exposures for each light setting, one with the camera in each position.

The reason that the photoflood bulb should be used without a reflector is that nearly all reflectors throw a bit more light into the center portion of the light circle and thus would upset the even grading of the light.

The films should be developed very carefully so that they will not show streaks, spots, or scratches. Two screens prepared by this method are illustrated. Three each of the lengthwise and crosswise graded screens will meet most requirements because they can be used in combinations.

When only a small area of the print needs to be held back, cut a mask from a small piece of black paper and skewer it on a piece of wire, which will serve as a shadowless handle to allow you to move the mask in a small circle in front of the area to be shaded, as shown in the last photograph.



When only a small area of a print must be held back, a shield may be made from a bit of black paper fixed on the end of a wire

The size of the piece of paper and the question as to how accurately it must conform to the shape of the area to be shaded depends on the job to be done. If, for example, only a slight lightening of tone is desired in an area approximately circular in shape, a square piece of paper will do just as well as round one, assuming that it is kept in rapid motion all the time it is in front of the print. On the other hand, if the area to be made lighter is long and relatively thin, then a piece of paper of about the same shape is best.

It often happens that a small area of the print is too light instead of too dark. The solution is to use a mask or black paper or cardboard larger than

(Continued on page 87)

HOW TO SHADE PHOTOS

(Continued from page 86)

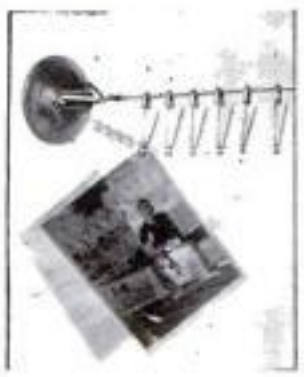
the paper or negative and cut an opening in it of about the size and shape of the object to be printed darker. Make the exposure, without the mask, as long as you have already found to be right for the rest of the picture; then move the mask into place so that the light through the opening reaches the section that needs more printing, and continue the exposure for a length of time that will depend on how much extra light is required to get the right effect. This may amount to from twenty-five to a hundred percent or more of the unmasked exposure. Be sure to keep the mask moving in a small circle all the time it is in use to avoid the formation of objectionable lines.

FLATIRON WAX POLISHES FERROTYPE PLATES

WHEN using ferrotype plates to give a high gloss to prints, the prints may sometimes stick to the tin with disastrous results. To avoid this difficulty, the plate may be rubbed with a prepared polishing solution or one made by dissolving paraffin in benzine. A bottle of gasoline and a flatiron waxer will perform the same function more conveniently. Pour a little gasoline onto the center of the tin and spread it with the waxer. Just enough parafiin will dissolve and pass through the cloth to form a thin film. When the gasoline exaporates, the plate can be polished with a cloth in the usual manner.

In place of a regular flatiron waxer, a substitute may be made by wrapping a piece of bar paraffin in muslin.—C. EDWARD LINDBERG.

FILM-DRYING LINE HELD WITH SUCTION CUPS



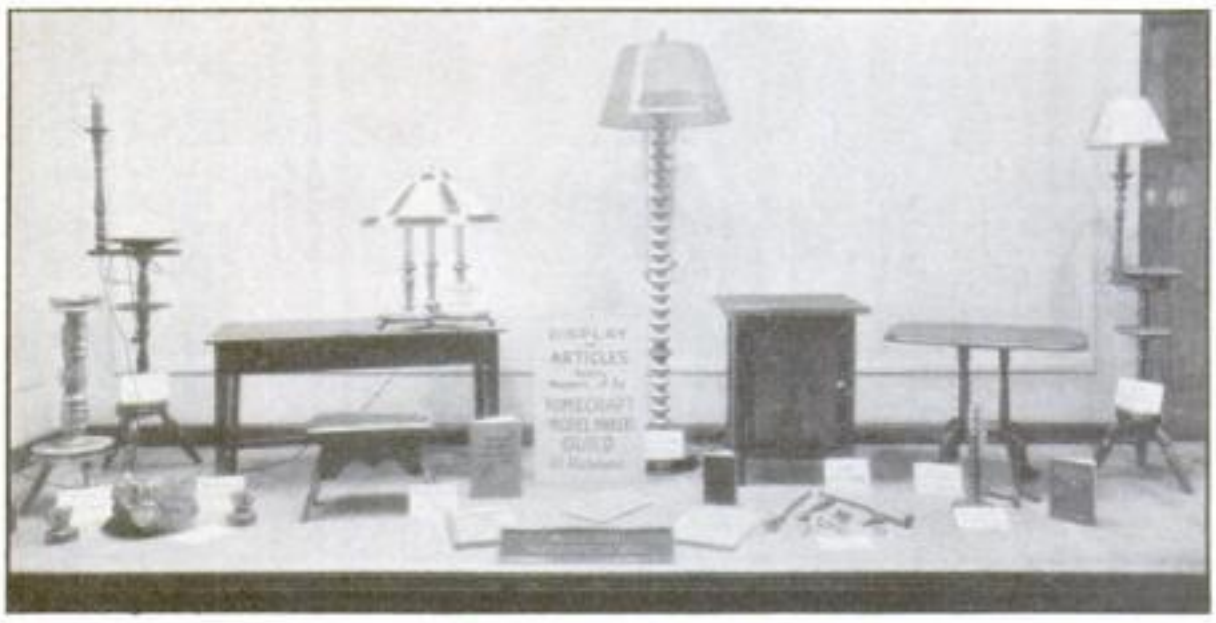
AMATEUR photographers will find the line illustrated is a great convenience in drying cut film and film-pack negatives. It consists of two rubber vacuum-cup coat hangers (sold in ten-cent stores), two wire hooks, a short length of strong fish-line, a dozen medium sized safety pins, and a stout rubber band.

The large metal hooks attached to the rubber cups are first removed and replaced by others of light wire. The safety pins are then strung on the line as shown. A loop is made on one end of the line, and the rubber band is fastened to the other.

In use, the point of one of the pins is forced through the wet negative at the extreme corner. When dry, this perforated corner should be snipped off with shears to prevent the projecting edge of the hole from scratching when the negatives are placed one on another.—DON C. COLEMAN.

CLUBS PLAN MANY LOCAL EXHIBITIONS

(Continued from page 82)



This photograph and one at the beginning of the article show an exhibition of the Homecraft and Modelmakers' Guild, Richmond, Va., in windows of the Methodist Publishing House

Topeka before the opening of the show.

So rapid has been the growth of the National Homeworkshop Guild and so important is the place it now holds in the field of amateur craftsmanship that it is difficult to realize how such remarkable results could have been accomplished in so short a time. This month marks the Guild's first birthday. The announcement of its organization appeared a year ago in the December, 1933, issue of POPULAR SCIENCE MONTHLY. There was then only one club in the Guild—the parent club in Rockford, Ill., where the Guild was incorporated and where it has its national headquarters.

Not until the February issue of this year was it possible to announce the first new clubs to be organized, and there were only seven of them—in Topeka, Kans., Dixon, Ill., Silverton, Colo., Cody, Wyo., Amarillo, Texas, Cincinnati, Ohio, and Fairfield, Ala. Since that time, however, clubs have been established all over the country. They are now located in 106 different cities and towns. The complete list was published last month. This is an extraordinary record. It means that new home workshop clubs were organized throughout the entire first year of the Guild's life at the average rate of two a week.

The reasons for the great success of the Guild are quite clear. It provides, for the first time, a national organization devoted exclusively to the interests of men who make a hobby of their home workshops. It gives them a chance to meet regularly, to see instructive demonstrations in various types of craftwork, to work together, to discuss their mutual problems, to examine each other's work, and to enjoy genuine comradeship in their hobby.

The fact that the Guild is entirely noncommercial and is able to provide many valuable services for the affiliated clubs has contributed to the success of the movement. Its officers serve without pay, it is sponsored by an advisory council of distinguished men, it has POPULAR SCIENCE MONTHLY for its official magazine, and, in addition, it publishes its own monthly bulletin.

The outstanding feature of the Guild's 1935 program will be its National Exhibition and Contest. It has finally been decided to hold this event in Chicago the last week in March. As previously announced (P. S. M., Oct. '34, p. 72), $2,000 in cash prizes and ten silver trophies will be awarded at that time. Complete details of the contest will be sent to the affiliated clubs and to all new clubs that are organized in time to take part in the competition. For information in regard to how to start a club, fill out the coupon.

CLUB NEWS IN BRIEF

LeVern T. Ryder, president of the Guild, has been invited to address the annual convention of the American Hardware Manufacturers Association, which is meeting in Atlantic City, N. J., as this issue goes to press. He will outline the purposes of the Guild and tell what it has accomplished.

The Topeka Club held its exhibition in conjunction with the Kansas Free Fair. A continuous moving picture was presented at its booth. This showed members of the club doing various types of craftwork. E. H. Johnson, a member of the club, took two first prizes for hammered brass at the fair.

The Queen City Homecraft Club of Elmira, N. Y., is putting on a local membership drive. Prizes for the contest have been donated by various local stores. A talk on seafaring matters of particular interest to ship model makers was given at a recent meeting by Lawrence Ferguson, chief master-at-arms of the *Southern Cross*.

Members of the Homecraft and Modelmakers' Guild of Richmond, Va., are constructing half a dozen smoking stands and a small table for the club's use. Its library has been established temporarily at the Y. M. C. A., where meetings are now held. The club has staged two contests, one on bird houses, in which L. J. M. De Jong took the prize, and another on lamps, won by G. H. Smith. The club has grown from eight to thirty members. Among them are several doctors, post-office clerks, machinists, a policeman, a watchmaker, the chief probation officer of Richmond, a Y. M. C. A. official, an officer of a construction company, several draftsmen, and a few college students.

The Creston Homeworkshop Club of Creston, Iowa, and the Port Leyden Homeworkshop Club of Port Leyden, N. Y., have been chartered.

National Homeworkshop Guild
c/ o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me this information in the large self-addressed and stamped envelope I am inclosing.

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There are 9 Different Outfits for Your Selection

They come in cardboard boxes, sturdy Wooden Cabinets, and the New Laboratory Style Cabinet. All Outfits except No. 1 have separate, removable Test Tube Stands.

No. 1	$1.00
No. 1½	1.50
No. 2	2.00
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Above is Set No. 2, a very useful one for the beginner. The Manual of Instruction explains and demonstrates more than 240 scientific experiments, all of which can be performed with the 34 different chemicals and pieces of apparatus which the set contains. An unusual feature is a large, removable, wooden test tube rack, a great convenience for the experimenter. **Price $2.00**

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This is the new CHEMCRAFT Laboratory Style Cabinet, an exclusive development in chemistry sets which provides every convenience for the experimenter.

Here is the most complete chemistry laboratory obtainable in a single unit. It is CHEMCRAFT No. 25. Contains every chemical and piece of apparatus required for a complete course of practical instruction in chemistry. **Price $25.00**

There are other sets in this CHEMCRAFT Laboratory Style Cabinet at $7.50, $10.00 and $15.00.

This is No. 5, a larger set in a sturdy wooden cabinet. There are 67 chemicals and pieces of apparatus, among them many costly chemicals and pieces of scientific apparatus. More than 400 scientific experiments, many of them on advanced subjects, are explained in the Manual of Instruction, and a separate Note Book for keeping records is included. **Price $5.00**

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TOYS, furniture, models, and other projects suitable for Christmas gifts are contained in the POPULAR SCIENCE MONTHLY blueprints. These are each 15 by 22 in. and cost 25 cents a sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

Many other blueprints are available. Send a stamped and addressed envelope for a complete list.

FLYING AIRPLANE MODELS

Bremen (Junkers, 3-ft.), *89-90*	$ .50
Nieuport XVII, 29-in., *180-181*	.50
S. E. 5a World War Plane, 30-in., *168-169*	.50
Winnie Mae, 4-ft., *141-142-143*	.75

BOATS

*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., *192-193-194-R*	1.00
*Duck Boat, Folding, *170-R*	.50
*Outboard Racer, 10½-ft., 114 lb., *211-212-R*	.75
*Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*	1.00
Marconi Rig with Jib for Above, *133A*	.25
*13-ft. Rowboat-Motorboat, *147-R*	.50
*14½-ft. Rowboat-Motorboat, *148-R*	.50
*16-ft. Rowboat-Motorboat, *149-R*	.50
Stern Drive Installation (when used with rowboat-motorboat), *150*	.25
*15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224-R*	.50

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

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Bookshelf and Book Ends, Modernistic, *100*	.25
Chests, Treasure, *78*	.25
End Table, Magazine, *68*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Pier Cabinet and Corner Shelves, *77*	.25
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Stand, Low Modernistic, *100*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, Oak (top 20 by 24 in.) *140*	.25

RADIO SETS

All-Wave Portable (battery), *217-R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three-Stage Audio-Frequency, *42*	.25
Five-Tube Short Wave (A.C. or D.C.) *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page 10}

Aircraft Carrier—U. S. S. *Saratoga* (18-in.) and flush deck destroyer (6¼-in), *226-227-R*	.75
Battleship—U. S. S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper Ship (20½-in. hull), *51-52-53-R*	1.00
Clipper, Simplified (9½-in. hull), *219*	.25
Constitution (21-in. hull), *57-58-59-R*	1.00
Cruiser *Tuscaloosa* (11¾-in.), *234*	.25
Destroyer—U. S. S. *Preston* (31½-in. hull), *125-126-127-R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (33½-in. hull), special prints *221-222-R*	1.50
Mayflower (17½-in. hull), *83-84-85-R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*	.50
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Model (20-in.), *196*	.25
Liner—*Aquitania* (9-in), *225*	.25
Liner—*Manhattan* (12 in. long), *204*	.25
Liner—*St. Louis* (11-in.) *231*	.25
Privateer of 1812—*Swallow*, a Baltimore clipper (13-in. hull), *228-229-230*	.75
Roman Galley (19-in.), *138-139-R*	.75
Santa Maria (18-in. hull), *74-75-76-R*	1.00
Schooner—*Bluenose* (17½-in.), *110-111-112-R*	1.00
Stagecoach with horses, *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Steamships *Savannah* (3½ in. over all) and *Atlantic* (6 in.), *235*	.25
Viking Ship (20½-in.), *61-62-R*	.75
Whaler—*Wanderer* (20½-in.), *151 to 154*	1.00
Yacht *Rainbow* (7½-in. hull), *233*	.25
Yacht *Sea Scout* (42-in. racing), *106-107-R*	.75
Yacht (20-in. racing), *48-R*	.50

MISCELLANEOUS

Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig-Sawed, *56*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....

Patterns for.....

Reprints alone for.....

I am inclosing.....dollars.....cents

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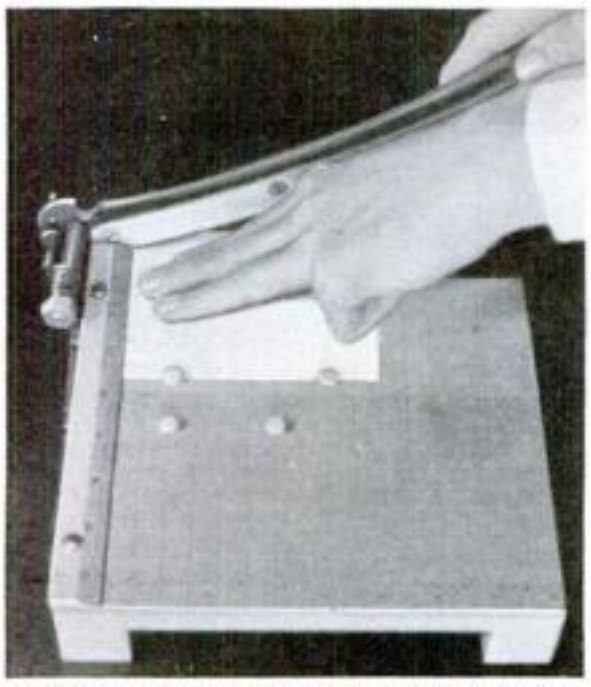
City and State.....

Please print your name and address clearly.

Toy Fire Engine Pumps Water

BOYS like toys that really work, such as the fire engine shown on our Blueprint No. 101, price 25 cents. This sheet also contains drawings for a toy tractor built entirely of wood, a dump truck, and a sprinkler truck with a tank made from a tin can. Another good toy blueprint is No. 113, which has plans for a tiny lathe, drill press, circular saw, and jointer, all of which work. It also costs 25 cents. For girls there is the Colonial doll's house (Blueprint No. 72) with a separate sheet showing how to make suitable furniture for it (No. 73). The price of each of these blueprints is 25 cents.

THUMB TACKS SERVE AS TRIMMING GUIDES

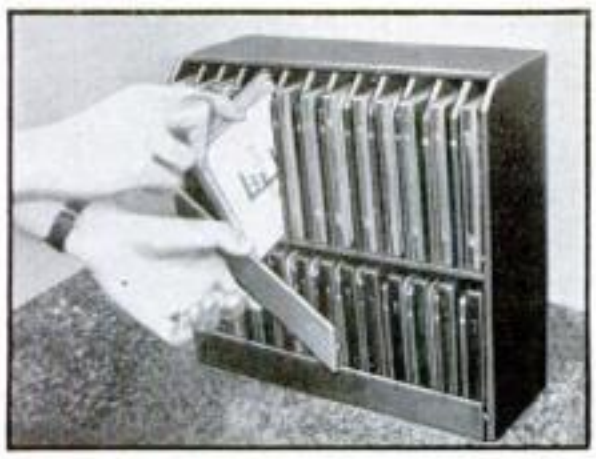


Using thumb tacks as paper guides. In this way, film can be cut accurately in the dark

THUMB tacks used as guides on a trimming board save time and insure accuracy when it is necessary to cut a number of cards down to a specified size. This method is also useful where supersensitive photographic film must be cut in total darkness. The illustration shows the position of the guides for reducing 4 by 5 in. negatives to the 9 by 12 cm. size taken by a good many plate cameras.—RALPH PAGE.

PHOTO NEGATIVES FILED IN CIGARETTE TINS

A CONVENIENT dustproof filing case for photographic negatives can be made from old cigarette tins and a wooden cabinet of the type illustrated. One tin is allotted to each letter of the alphabet, so any desired

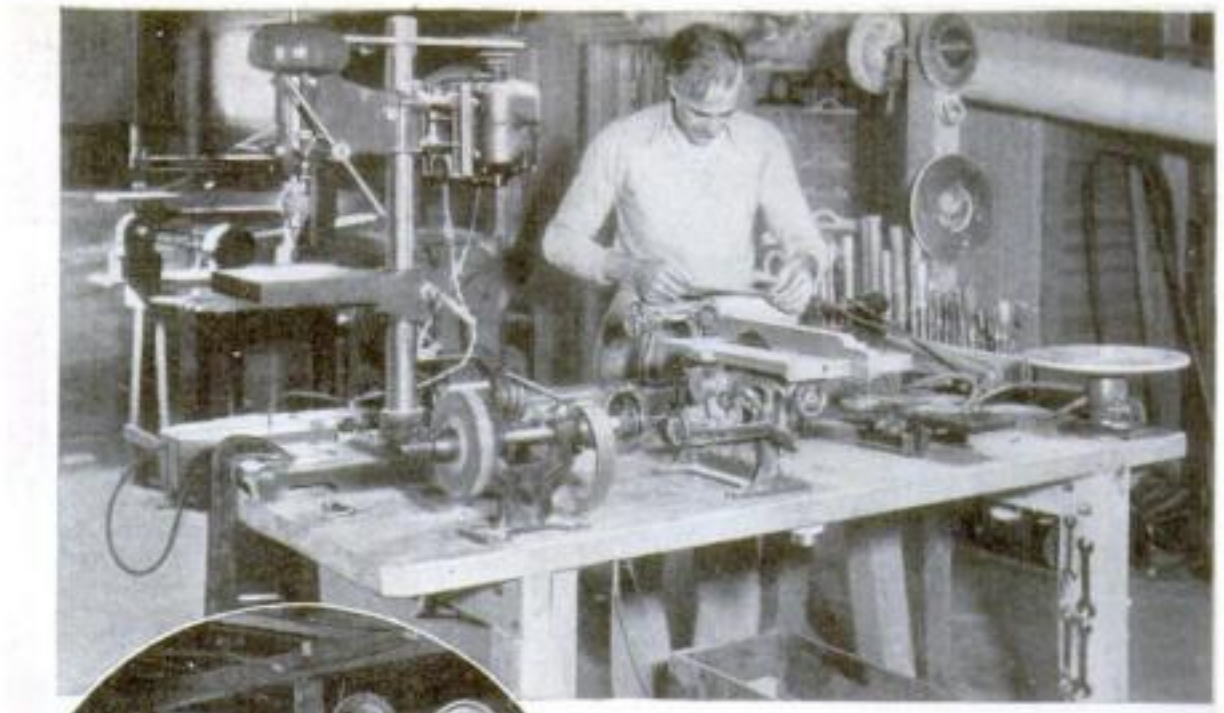


This neat, dustproof, and compact negative file has a capacity of more than 350 films

negatives can be found in an instant. The file shown contains about 350 negatives, from 4 by 5 in. down, and is still far from being filled to capacity. When a tin is filled, it can be replaced with an empty one and stored away.—JACK FEELEY.

SHIP MODEL SAILS MADE OVER WIRE GAUZE

TO MAKE satisfactory sails for small ship models, I cut them from wire gauze and, after giving them the proper shape, cover the gauze with a thin coating of plastic wood composition. Then I gradually build them up to the required thickness, let them dry, and sandpaper them until smooth. If an antique appearance is desired, a thin coating of orange shellac can be applied and immediately rubbed off as far as possible with a cloth.—ROGER B. WOODBURY.



HINTS ON LAYING OUT AN EFFICIENT

Basement Shop

WHEN ample space is available for a basement shop, the problem is to concentrate the equipment sufficiently to save unnecessary steps, yet leave room enough to operate all machines freely. The shop of Lowell R. Browne, Monrovia, Calif., which is illustrated in the photographs above and the floor plan below, is a good example for those who can buy only one machine at a time. A somewhat different layout from Fig. 1 might be made, of course, if all the equipment could be bought and installed at once.

A large homemade lathe was the first machine acquired. Then were added a jointer, circular saw, grinder, shaper, and drill press. These are grouped on a substantial bench built as shown in Fig. 2. Some of the machines have individual drives, but most of them are driven from a countershaft powered by a ½-H.P. motor.

A band saw and a large jig saw have individual drives and are placed to best advantage in respect to light and handling room. A portable worktable, Fig. 3, facilitates carrying work from one machine to another. Lumber is stored on a rack built as in Fig. 4.

The artificial illumination is exceptionally well distributed, and the daylight is to be increased by putting windows in the foundation as indicated by the shaded portions of the diagram showing the general arrangement of the shop.—HI SIBLEY.

This is the fourth of a series of articles on laying out small shops.

Photographs Wanted . . .

of well-arranged shops.

If your shop has some features that other readers might profit by, please send one or two clear photographs and a diagram of the general layout to the Home Workshop Department. The best contributions will be paid for and published.

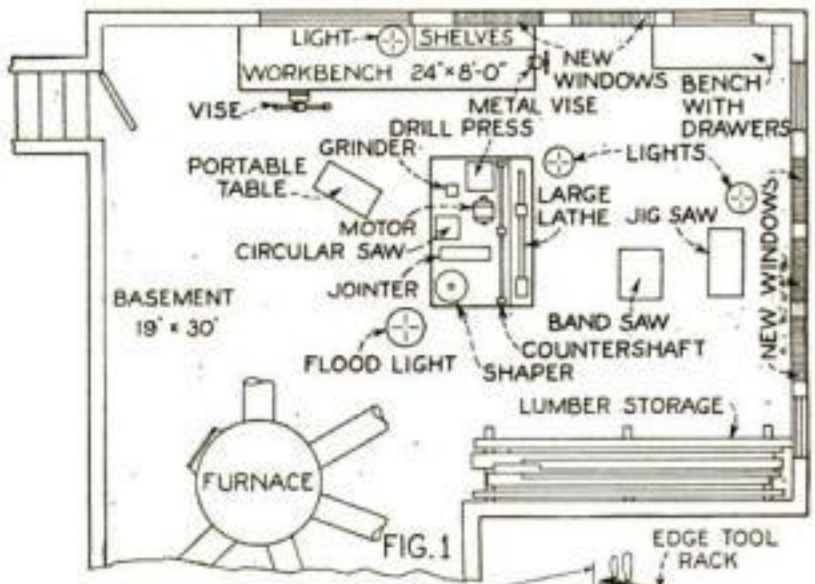


FIG. 1

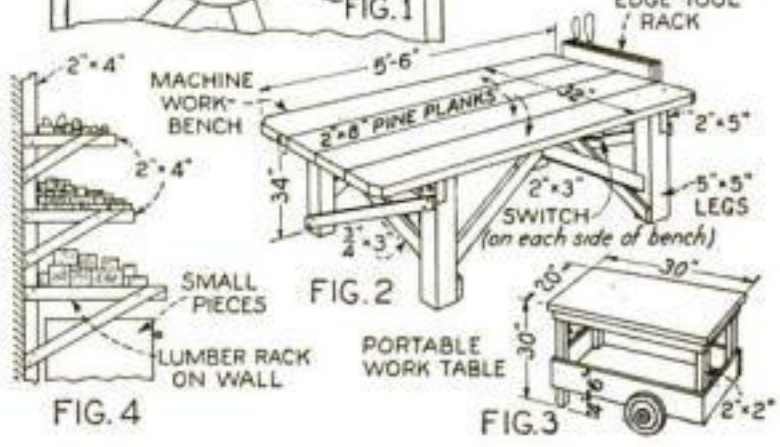


FIG. 2

FIG. 4

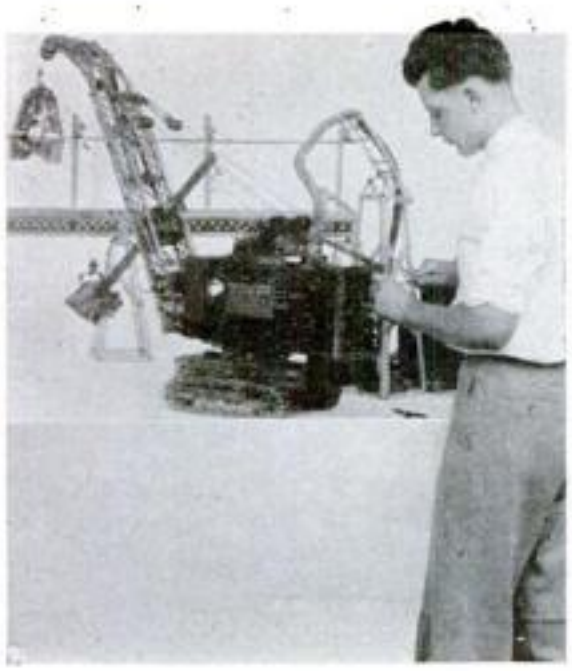
FIG. 3

PORTABLE WORK TABLE

Floor plan showing a step-saving layout of machines in a basement; and the bench, portable table, and lumber rack

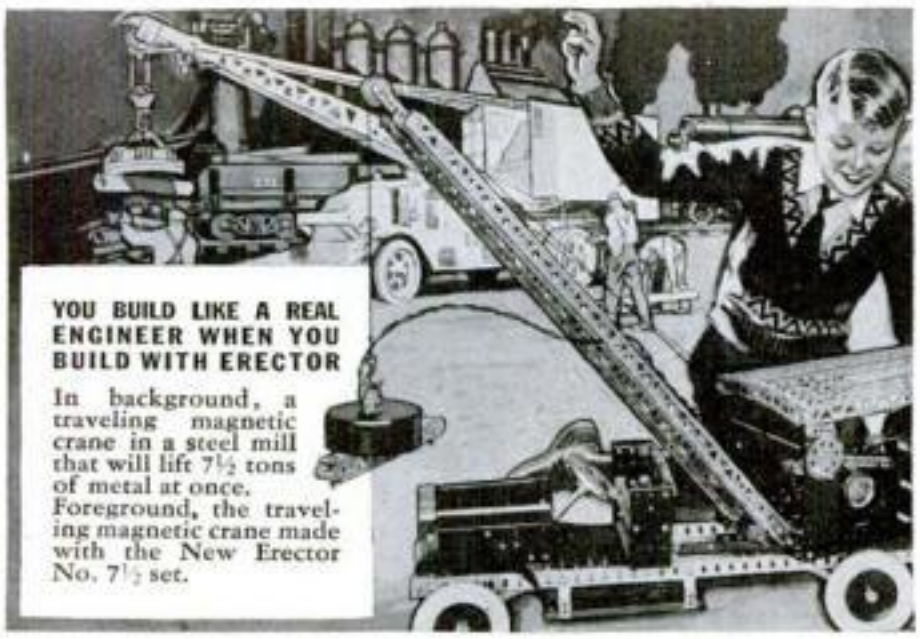
ERECTOR BOY ENGINEERS WIN BIG PRIZES!

NOW COMES A FINER ERECTOR · · AND A BIGGER PRIZE CONTEST · · FREE CHEVROLET GRAND TOTAL OF 1,001 PRIZES!



FIRST PRIZE WINNER LAST YEAR—Here is Eugene White, Jr. of West Fairview, Penna. with his marvelous model of an electric crane and shovel that captured first prize in the 1934 Erector Contest. Look! It's as big as he is. Eugene had his choice of a free trip to any place in the United States, but decided to use the money towards a college education.

DID MURRAY STRASBERG (Right) FEEL PROUD WHEN HE WON A CHEVROLET CAR!—Murray has had an Erector since he was six years old. He has built models of engines, trucks, bridges and dozens of other things. "It was fun making the model of the road making machine that I won the prize with," says Murray, "and now I'm having more fun with my new Chevvy." *With Murray are "Spike" Butler (left) of the Erector radio programs and Casey Jones, famous aviator.*



YOU BUILD LIKE A REAL ENGINEER WHEN YOU BUILD WITH ERECTOR

In background, a traveling magnetic crane in a steel mill that will lift 7½ tons of metal at once. Foreground, the traveling magnetic crane made with the New Erector No. 7½ set.

THE NEW ERECTOR SENSATIONAL No. 7 SET—Contains the powerful Gilbert 110-volt motor, all-purpose gear box, girders, gears and other real engineering parts for building over 150 action models. Erector Sets start at $1.00. Be sure to see the Famous No. 4—the "Super-6" Erector—and the Sensational No. 7.

HELLO BOYS!

Can you think of anything you can own that will give you so much thrilling fun as Erector? Just listen to this.

With Erector you can build a trench digger—with a real electric motor in it—and make it work just like the ones you see on the highways. You can construct motor trucks, fire engines, aeroplanes, locomotives. Put them together—piece by piece—with your own hands. You can build drawbridges that actually open and close—a towering ship crane such as used in Uncle Sam's Navy Yards—a mighty hoisting engine—and dozens of other thrilling engineering marvels . . . Then you can hook up the powerful Erector electric motor and make them hum with action. You are a full-fledged engineer when you have an Erector—because Erector is just like real engineering.

TUNE IN

"THRILLS OF TOMORROW"—Follow "Spike" Butler in his hair-raising adventures. NBC—WEAF network, Fridays, 6:00 P. M. See your local newspaper for other NBC stations.

HERE'S YOUR CHANCE

To Win a Brand New Car or Other Valuable Prize!

How Eugene and Murray won their exciting prizes are all true stories. Now you can do the same. This year I am having another Erector Contest—with *better* prizes than before. First prize is a Chevrolet auto. Then there are bicycles, cameras—a total of 1001 thrilling awards.

So right now, do these two things. First, mail the coupon below, and I'll see that you get my big illustrated "Look-'em-over" Book and an entry blank for the prize contest. Then go to the nearest toy store and pick out the Erector you want. Take your Dad along. He'll want to share in the fun . . . And good luck in my big prize contest.

Your friend,

A. C. Gilbert

FREE—Clip the Coupon

Mr. A. C. Gilbert, The A. C. Gilbert Company,
422 Erector Square, New Haven, Conn.

Send me the big colored Erector "Look-'em-over" Book and entry blank for the Erector Prize Contest—both free.

Name .....

Address .....

City ..... State .....

Roomy Magazine Rack

DESIGNED IN LADDER-BACK STYLE

By HERMAN HJORTH

IN DESIGN, this large and decorative magazine rack resembles a Chippendale ladder-back chair.

Cardboard patterns should first be made of all the curved parts. Saw the pieces on the band saw or with a turning saw. Before sawing the curved rails, however, plane the ends of the board square and true.

The rails are joined to the uprights with two ¼-in. dowels in each joint. When the joints fit, the upper edges of the rails are rounded slightly with file and sandpaper, and the uprights are grooved as shown. This is easily done with a scratch stock. The sides are now ready for gluing and clamping.

The next step is to join the ends to the two sides with dowels. Cut the ends so that the grain runs horizontally from side to side, not up and down. The center partition is joined to the ends by means of stopped dado or gained joints. A groove ⅛ in. deep is cut along the center of each end piece. It should be equal in width to the thickness of the partition and should stop about ½ in. from the top of the ends. When the joints are fitted, the sides, ends, and center partition are glued together.

The bottom, the edges of which may be molded on a shaper or with a scratch stock, is now screwed in place. The feet should be made from one piece, which is squared to dimensions and then cut into 3-in. lengths. The pattern is marked as shown. One side is cut on a band saw to within ¼ in. of the top; the other side is then cut through, after which the first cuts are completed. The legs are smoothed with file and sandpaper and fastened to the bottom with glue and screws.

The magazine rack should now be thoroughly inspected and sanded. It is given a coat of stain and high-lighted when dry by rubbing with No. 2/0 steel wool or sandpaper. It may then be given three or four coats of very thin shellac. A 5-lb. cut of shellac should be reduced 50 percent by the addition of denatured alcohol. Rub between coats with No. 2/0 steel wool. The last coat may be rubbed to a smooth finish with waterproof sandpaper No. 6/0 and crude oil.

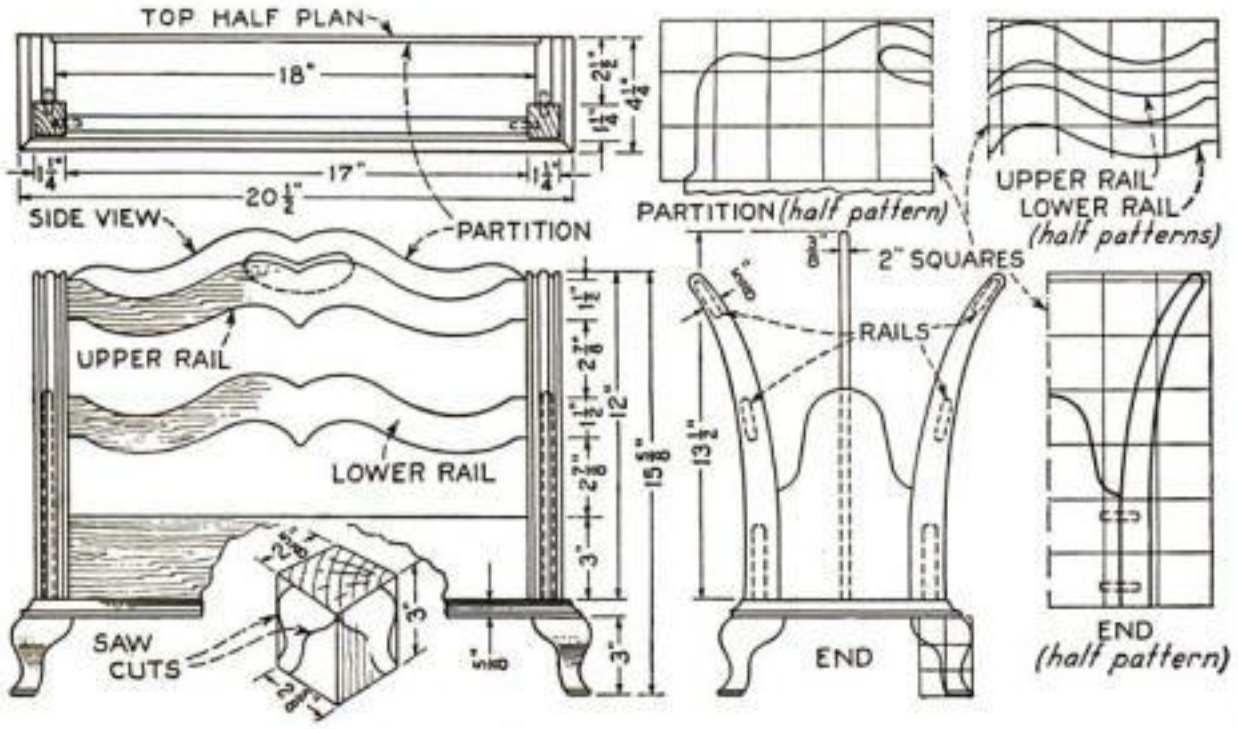
List of Materials

No. of Pieces	Description	T.	W.	L.
1	Uprights (4)	1¼	4½	24½
2	Curved rails (4)	⅜	5	17
2	Straight rails	½	3	17
2	Ends	½	8	5
1	Center division	⅜	13½	18¼
1	Bottom	⅝	8½	20½
1	Legs (4)	2⅝	2⅝	12½

NOTE: Dimensions are given in inches.

INK FOR WRITING ON METAL

WRITING can be done on metal surfaces with equal parts of copper sulphate and potassium chlorate, dissolved in sufficient water to make a strong solution. A quill pen should be used. The writing soon turns into an intense, permanent black.—M. R. Y.



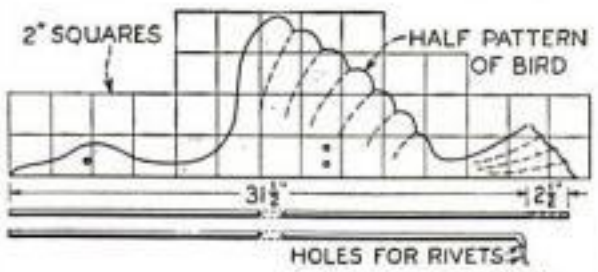
Side and end views, half of the top plan, half patterns of curved parts, and layout for feet

METAL BIRD IS FEEDING PLACE FOR REAL BIRDS

THIS unique metal bird is not only an ornament for the yard, but it also serves most appropriately as a receptacle for bird food. Because of its high legs, which are simply stuck into the ground, it enables the birds to feed without danger from cats.

A half pattern, as shown on the drawing, is laid out and cut from heavy wrapping paper or cardboard. This is placed along a center line marked on a sheet of 16-gage soft iron 16 by 28 in., and the outline is drawn on both sides of this line. The bird is then cut out with a pair of tin shears.

Draw the lines indicating the feathers in the wings and tail, place the sheet on a flat iron surface and outline these with a blunt



How to lay out a pattern for marking the outline of the bird on the sheet iron; the legs; and, at right, sketches showing the assembled feeding place

cold chisel. Now turn the sheet around and cup or hollow the feathers with a ball-peen hammer. A hard end-wood block may also be used to support the metal.

The head and neck are cupped, and the beak is hammered into a V-shape. The body is then rounded slightly with the hammer, and the wings, tail, and neck are bent into shape.

The legs are made from two ⅜-in. iron rods, 34 in. long. One end of these rods is heated and hammered flat for a distance of about 2½ in. More than one heating may be necessary. The flattened ends are bent while hot to fit the underside of the bird, to which they are riveted with ⅛-in. iron rivets.

The bird may be painted white except the beak and the legs, which are given an orange or other contrasting color. The eyes are indicated with two black dots.

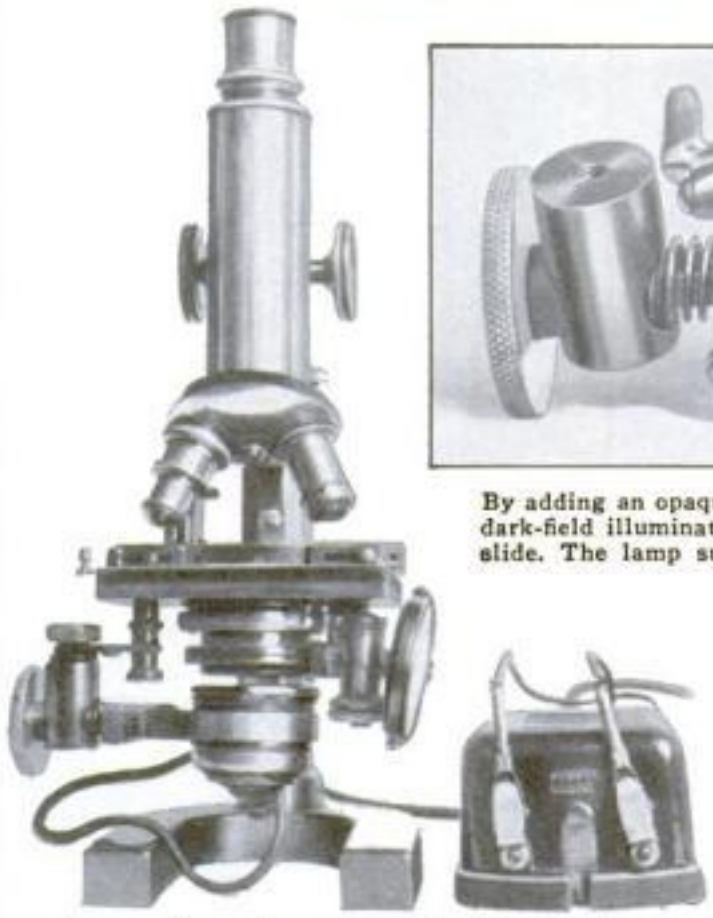
A smaller bird of the same design may be made for a table decoration and mounted on a suitable base.—DICK HUTCHINSON.

After the feathers have been lightly cupped, the neck and head are hollowed with a hammer

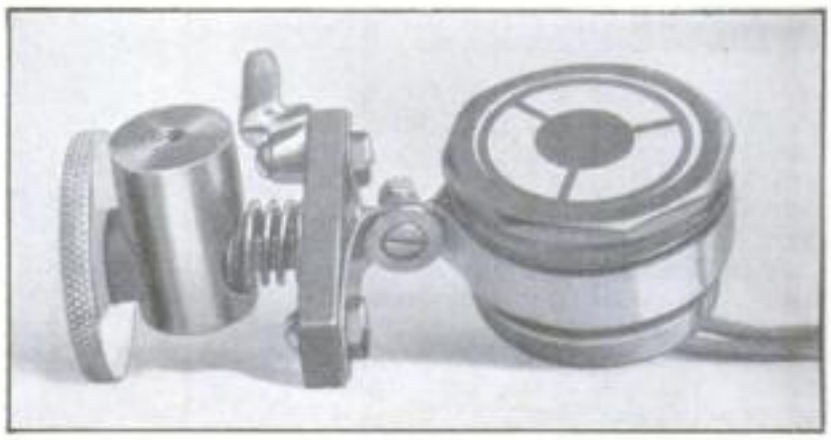
CONDENSER TYPE

Microscope Lamp

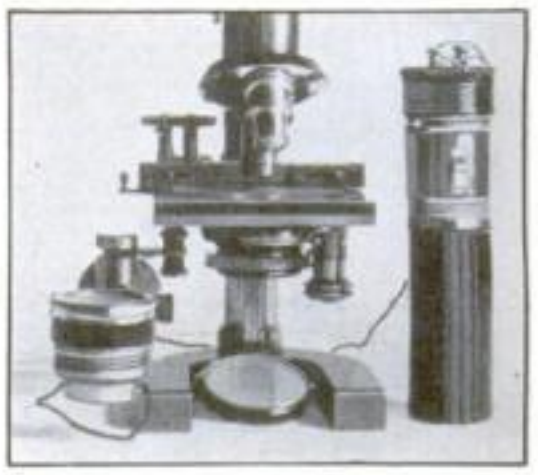
Made from Cheap Flash Light



Homemade condenser type of understage lamp with bell-ringing transformer. It can also be operated, as at right, by flash-light batteries in a case



By adding an opaque disk in the center, the lamp provides dark-field illumination, which develops more detail in the slide. The lamp support is part of an old telegraph key



POOR lighting is the chief cause of poor results with the microscope. The condenser type of lamp to be described has many advantages over other methods of lighting and can be made from an inexpensive bull's-eye flash light.

The bull's-eye lens should be removed and ground on the flat side until a frosted white color. Use the flat side of an emery wheel, and finish with emery cloth. Then grind the lens down with very fine powdered emery on a flat piece of glass to remove all scratches.

If the top part of the flash light is too long to fit under the stage, it should be sawed off. The bright reflector is discarded because the lens is reassembled with the round part facing the light bulb. It is suggested that a piece of blue ground glass be placed over the flat side of the lens to give a daylight effect. If it is not ground, rub the blue glass over a piece of very fine emery cloth.

The lamp is wired by fastening a small copper strip, insulated with thin cardboard, to the frame of the light. The copper strip makes contact with the soldered tip on the light bulb. The other wire is fastened to the disk where the light bulb screws in. In most flash lights this disk is insulated from the case. The two wires are then connected to a bell-ringing transformer through a variable resistance wire, or to flash-light batteries. For the microscopist who does his work in the field, a convenient way to house the flash-light batteries is to make use of the parts of the flash-light case not required in making the light.

The finished light in this instance was attached to the microscope by using part of an old telegraph key, but one can mount the light on a neatly painted block of wood under the stage, or perhaps drill a hole under the stage and thread it, then screw a long bolt in under the stage, thus making a support to fasten the light to by means of brass strips with a thumb-screw arrangement.

The dark field illuminating feature can be added by making several opaque disks. For example, if the worker is using a 16-millimeter objective, he should place a 16-millimeter disk in the center of the light. We used a ten-cent piece for laying out the disk; it is about 17 millimeters. When the disk is in place, swing the light under the microscope and you will notice that in one place the slide is brightly lighted. By moving the light slowly, the slide will appear to have a dark background, yet the slide itself will be illuminated and will show more detail than with the bright light only.

With this type of lamp and the dark-field disks, the amateur will be better able to probe nature's secrets.—O. M. FREEMAN.

Lamp from below, diagram showing how lens is set, and disk for producing dark field

HOMEMADE FURNACE

(Continued from page 73)

screwed in. This piece of pipe had two openings, each about ¾ in. square, one on each side, about 1 in. from the outer end. A sleeve was made to slide over these openings to control the mixture of air and gas. A pipe cap, drilled and tapped for ⅛-in. pipe, was then screwed on the outer end of the pipe.

A piece of brass rod about 3 in. long was then threaded with a ⅛-in. pipe thread on the outside for about 1½ in. of its length. The outside of the other end was corrugated for the gas hose connection. This piece was drilled out ⅛ in. in diameter, and the threaded end was bushed down to 1/16 in. to reduce the flow of gas. The piece was then screwed into the pipe cap and held in place with a lock nut. The long running thread on this part is for the purpose of adjusting it to get the best flame in the burner.

THE top of the tee was faced off and the thread bored out. A piece of cast iron was machined with a shoulder to fit over this, to hold a piece of screen and also to receive the legs that hold the crucible and baffle. This ring was fastened to the tee with three ¼-in. roundhead machine screws. The screen is ordinary mosquito netting, doubled.

The legs are made of ⅜-in. cold-rolled steel, heated and bent, and the lower part threaded full length with a ⅜-in. machine thread. This running thread is so that the legs can be adjusted to get the crucible in the hottest part of the flame and also so the lugs that hold the baffle can be adjusted to the right height. The legs are locked in position with lock nuts, and the lugs are also locked with lock nuts.

The baffle is made of asbestos cement. This was constructed by first bending a tin cylinder about 1 in. larger than the desired diameter and using an old 2-qt. fruit jar for a core. After the wet cement had been pounded into place, the glass jar was drawn out, and the baffle was set on top of the coal furnace in the cellar to harden. It shrunk about 1 in. in diameter while drying. The cover was made of the same material. This has a hole in the center, about 2 in. in diameter, to allow the hot burnt gas to pass out.

Any ordinary crucible, about 2½ in. in diameter by 4 or 5 in. high, can be used.

OLD aluminum crankcases or flywheel cases can be obtained from any automobile junk dealer and cut up into pieces.

The mold is made in sand in the usual way, but plenty of risers should be provided for in the mold (as shown in one of the photos) to allow the gas to escape. If this is not done, the metal will not run properly. It takes about fifteen minutes for each heat. The mold can be made while the metal is melting.

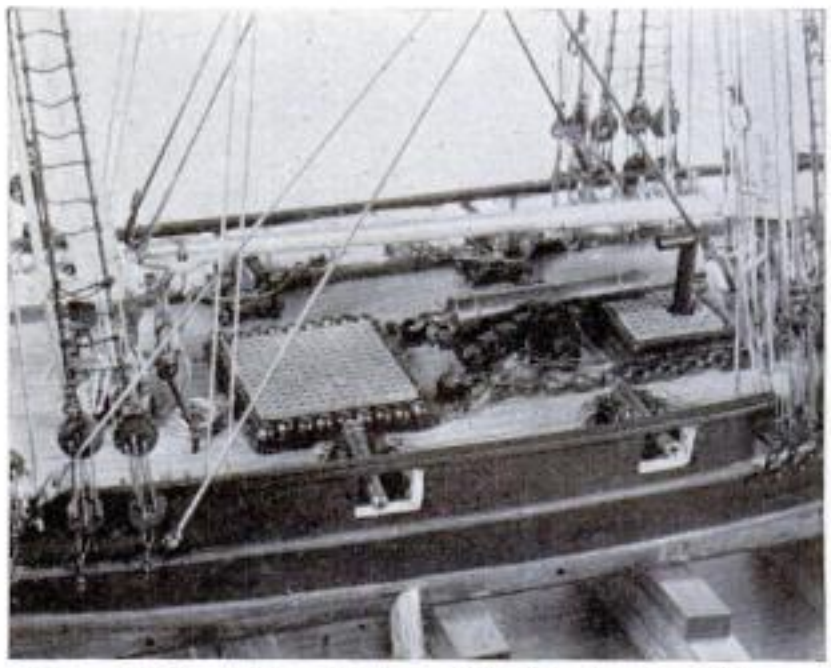
The lamp illustrated is an example of what can be done with castings made in this way. Three stainless steel rods, threaded at each end, are screwed into the top and fastened to the base with three nuts. The twenty-one glass tubes are from a dentist's anesthetic needle and had been discarded. They have rubber ends that serve as gaskets. What can be described as a "one-stepped" washer holds the porcelain socket. An intermediate base lamp, together with a cord and plug, completes the assembly.

The subject of making metal castings in the home workshop was covered in three previously published articles by Joseph C. Gilbert (P. S. M., Oct. '32, p.93, Nov. '32, p.96, and Dec. '32, p.102).

Going to build a ship model? You can save time by using one of our kits (see page 10).

COMPLETING HULL OF PRIVATEER MODEL

(Continued from page 71)



The midship section of the model. The large hatch has troughs on each side for carrying miniature cannon balls

are black and the pin rails brown. The channels need an eyebolt each, and one in the forecorner of the after ones. Details of eyebolts and ringbolts are shown in the accompanying drawings. They are made by twisting the small pins to shape, or in some cases, as for the mainstays and headgear, heavier pins are used. If you have any difficulty, make little staples.

The catheads—the L-shaped projecting timbers at the bow—also have to go on. These are best set in place before the main (or cap) rail because they should go under it, though in my model they cut through it. For these try to find a piece of twisted grain, or make them from twig forks, although a piece of hardwood cut diagonally will serve. The upright part lies on the bulwark against a timberhead and is nailed and glued in position. The outer end slopes slightly up and has four holes drilled in it for the cat tackle, and another inside for the stopper rope.

The boat davits, as shown in the deck plan and in two photographs used in this issue, lie on the cap rail and continue the line of the sheer. They also have four holes in the ends for the boat-tackle falls.

Several holes are needed in the hull. There are holes each side for the anchor cables, called hawse holes. The position of these is shown on the deck plan. An oblong hole is made in the stem for the gammoning lashing to hold the bowsprit down. There is a hole in the counter for the rudderpost to pass through. This must be very carefully made. It is best not to complete it until you try out the rudder for size and position, although that shown should be right.

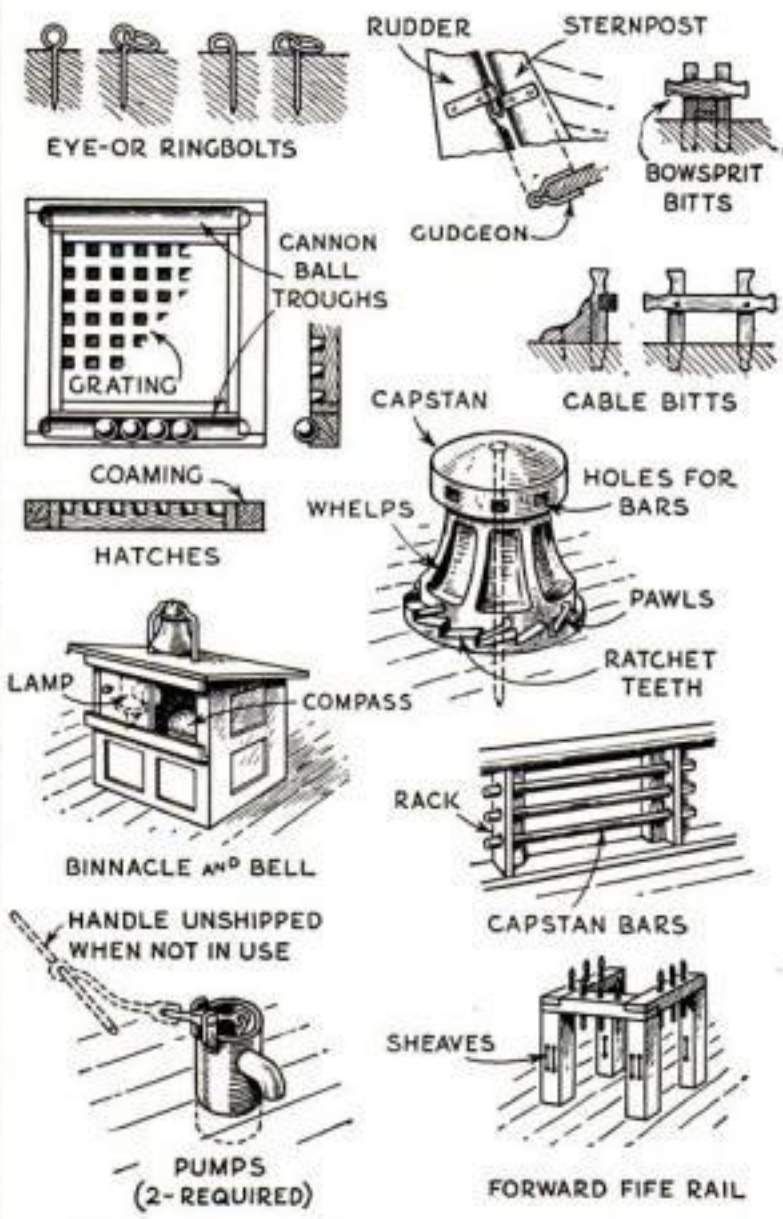
The rudder should now be fitted. Make it to the shape shown on the sheer plan (page 66 of the previous issue). It is 3/32 in. thick and tapers slightly to the back, with its front edge and the edge of the sternpost slightly rounded so that it will swing. The rudder post is square, bending a little forward where it passes through the deck. The tiller, which is mortised into the rudder post 3/32 in. from the top is 1/16 in. thick, ⅛ in. wide, and 1 3/16 in. long. It is slightly curved and tapered toward the end and is set parallel to the deck and ¼ in. above it.

For a simple model, nail on the rudder with two-pointed nails, or nail right through. For a fine model, fit it with gudgeons and pintles. The gudgeons (sockets) are of strip brass, bent and soldered around a No. 20 escutcheon pin and the pin removed. The pintles are the same, but with the pin soldered in. By careful drilling, you can rivet the straps from side to side. The rudder must be fitted close to the sternpost or the post will not go through the counter. If necessary, reduce the width of the sternpost slightly.

Before making the deck fittings, take a strip of paper and from the deck plan mark the position of all parts, including the masts. Transfer these positions to the center line of the deck.

Forward are the cross bitts for holding the bowsprit in position. This is just a crossbar notched halfway into two uprights, which are driven into holes in the deck and there glued. As the bowsprit does not quite come to the deck, a little block is glued to the deck between the bitts.

For this and other deck fittings, boxwood, holly, or any other wood of fine texture will do. I used degame or lemonwood through-*(Continued on page 100)*

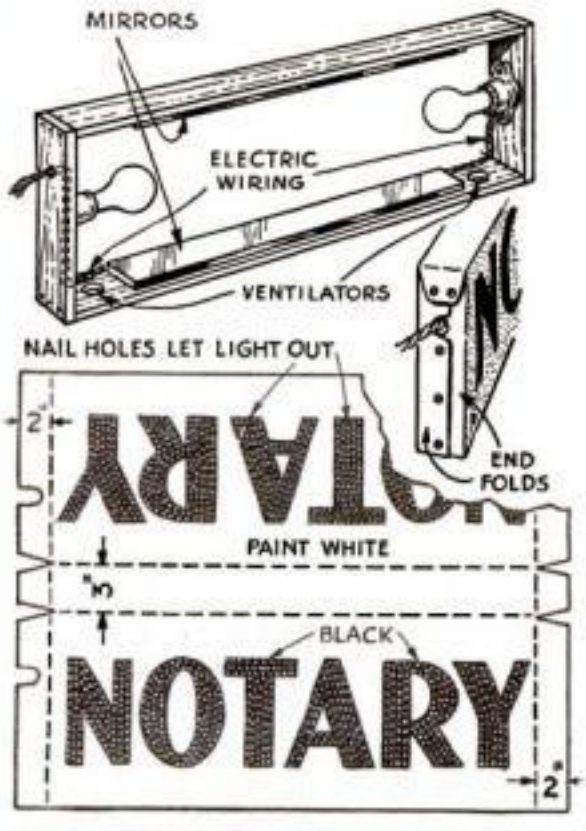


These drawings show the shapes but not the relative sizes

DOUBLE-FACED ELECTRIC SIGN COSTS LITTLE

AN ELECTRIC sign that appears lighted on both sides may be made at very little expense by the method illustrated. First prepare a wooden frame from ¾ by 3 in. lumber. For the sign shown, the frame was made 12 by 30 in., but it can be any desired size.

Next fasten a strip of looking glass along both the top and the bottom of the frame on the inside. The upper glass may run the full length, but the lower one should be about 4 in. short at each end so that holes may be drilled in the bottom for ventilation. A standard light socket is placed at each end of the



The frame with lamps and mirrors, and how the tin covering is laid out and fastened on

frame, and 15-watt bulbs are inserted. The electric cord leading to the sockets comes out of one end of the frame.

From a 5-gal. lard can or oil can, cut a piece of tin as shown. Outline the word or words on the tin as illustrated; then lay the tin, face side up, on a plank and punch the letters full of holes by driving a large nail or spike through them with a hammer. Out line the letters first in this manner, then punch the centers. The tin is now bent around the frame, and the ends are fastened with screws.

Paint the complete sign white and the letters black. In this way you will have a sign that will show up well both day and night. There is no opening for changing globes, but it is a simple matter to unscrew one side and one end, which gives room enough to make these changes.—J. P. KNIPP.

MODIFIED SAFETY RAZOR GIVES CLOSE SHAVE

TO OBTAIN an extra close shave with a standard type double-edge safety razor, I filed off all the guard teeth on one side of the razor holder except the two end ones. I first shave rapidly with the guarded side and then finish more cautiously with the unguarded side. There is very little danger of cutting oneself because the tooth left at each end forms a satisfactory guard. It is important, however, not to remove them. Experiments made with a razor having all the guard teeth filed off on one side revealed that the corners of the blade were likely to cause small cuts, no matter how carefully the razor was used.—P. W. CALHOUN.

COMPLETING HULL OF PRIVATEER MODEL

(Continued from page 98)

Captain McCann inspects the finished model, which is one of the best he has constructed

out on this model, including all the spars.

The cable bitts are similar to those described except in shape. They have knees on the fore side as shown in the plans and detail drawing. Stain them brown.

There are five hatches, all the same except in size. The coamings (sides) can be square pieces of wood, slightly hollowed to take half the thickness of the gratings, or they can be built of rabbeted pieces. They are painted black. The gratings are best made of boxwood, with the cross strips half-lapped to the others, but the indentations can be punched with a square point or merely drawn on.

It gives a better finish to put troughs around three of the hatches for the shot for the 6-pounder guns, and one on each side of the large hatch for the 24-lb. shot. They are merely rabbeted strips of a size to take the shot, with half projecting. The size of the small shot is 1/32 in. and the large, 1/16 in. Gunshot can be obtained in about these sizes, or steel balls made for use in bearings may be bought in a bicycle repair shop.

The capstan can be turned or filed to its outside shape and then the spaces between the whelps (see detail) dug out with a tiny chisel, or the whole can be built up. The pawl channel is a separate piece cut all around to represent notches for the pawls. The latter are six pin points bent over and driven into the edge of the capstan. They are to prevent the capstan from slipping backwards. The capstan may be either brown or black.

Bars are required to turn the capstan. These are in racks, three to a side, glued to the bulwarks, as shown. They are actually round bars about 7 ft. long with square butts to fit in the holes in the head of the capstan. Make them look like varnished wood.

I gave the model a box-type binnacle. An upright teakwood cabinet, with a sliding door in the front—that is, the side facing abaft—shows a compass on one side and a lamp on the other.

On this hangs the bell. The photographs do not show it because I did not add it until later. It is 1/8 in. high and 1/8 in. across the mouth. It can be hung on a brass wire staple.

Cable pipes to lead the anchor chains below are short pieces of tube of a size to take the chain, set just forward of the main hatch.

There should be pumps on either side just abaft the mainmast, although these are not in the pictures either. They would probably be small hand pumps as shown clearly in one of the drawings. Pieces of tube will serve. The handles would be unshipped except when in use.

There are fife rails around both masts. Each has four posts with the toppieces half-lapped at the corners. The rails are drilled for belaying pins. The two forward posts need holes representing sheaves (wheels) for the boom-topping-lifts and gaff halyards to lead through. The forward posts at the foremast have one hole each for the topsail sheets. Do not fit these until you have bored for the masts and are sure that the latter will not touch them due to their rake aft.

Quite a number of bolts are required in the bulwarks, waterways, and deck. There is one in the waterways on each side of the gun ports, one in each timberhead beyond, four in the deck to hold the long 24-pounder down, and one in the stern for the mainsheet. There should also be one behind each gun to haul it in with, but I omitted these.

The foresheet needs a traveler, which is just a piece of wire bent at right angles and with the points driven in the deck. Thread a little ring on it before fixing.

Then, of course, there's "Charlie Noble," the galley funnel, which projects through the forward hatch. It is just a piece of round stick cut on a miter, glued together, and painted black.

The guns and carriages will have to be left to next month, when we shall also start the rigging.

EXTRA ELBOWS IMPROVE HACK-SAW FRAME

Hack-saw frame with extra elbows riveted on to give added weight and a firmer handhold

RIVETING an extra elbow section on each side of the frame of a hand hack saw at the forward end gives more weight and makes the blade bite into the metal with less effort. It also provides a more substantial handhold with which to push the saw downward. The extra elbows can be cut from a cheaper or a discarded hack-saw frame.—A. L. EVANS.

CAN LID KEEPS POKER FROM CAUSING FIRE

WHEN a hot furnace poker is hung against a wooden coal bin or wooden partition, the danger that it may start a fire can be eliminated by nailing the lid from a vacuum-packed coffee can or any similar type of tin cover at the point where the red-hot poker rests. The lid will hold it away from the boards. If necessary, the poker can also be bent just a bit about 12 in. from the handle to keep the remainder of the heated poker from touching the wood.—RAYMOND IDEN.

KEEPING SOLDER CLEAN

IF WIRE or stick solder has been left lying around and is dirty, I have found that it pays to polish the end with a piece of sandpaper before using it so that no dirt will be deposited at the joint.—J. E. POLISSO.

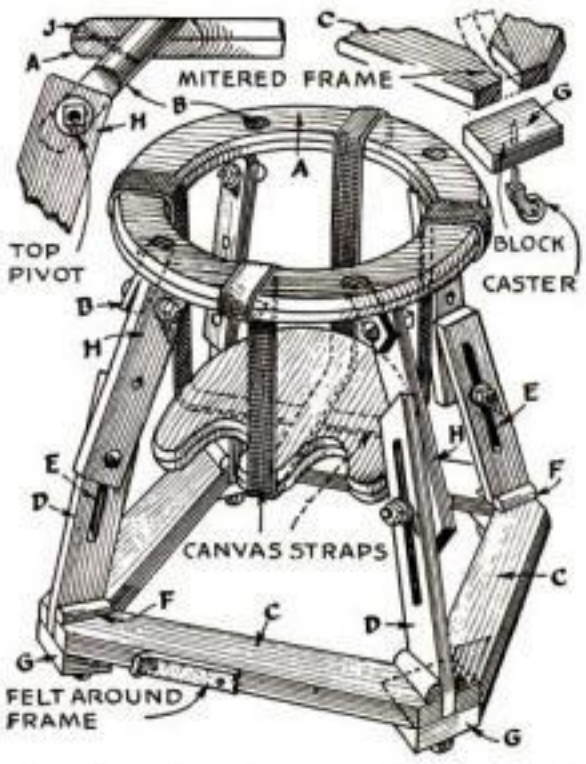
WALKER GIVES COURAGE TO HANDICAPPED CHILD

A walker that can be adjusted to give a child perfect support

BABIES who are backward in learning to walk or children who are partially crippled, blind, or otherwise handicapped will make greater progress with the aid of an adjustable walker like that above.

The circular top *A* is sawed from a piece of 1¼ or 1½ in. lumber 18 in. square, and four ⅞-in. holes are bored as indicated to receive 3-in. long pins *B* made from a broom handle. The bottom frame and legs are ¾ by 3 in. lumber of good quality. Pieces *C* are 26 in. long, and *D* may be from 12 to 16 in. long. Slot *E* is 5/16 in. wide and 6 in. long. Lean legs *D* inward at the top until the opposite ones are 18 in. apart. Fasten securely and reënforce with molding *F*. Add blocks *G* for casters.

Make pieces *H* ¾ by 3 by 12 in. For the seat use two thin boards, nailed crosswise. Fasten two canvas strips 2½ in. wide and of suitable lengths on the circular top and under the seat. Let the seat tip forward a little. Bolt the upper legs to the four wooden pins, attach the upper to the lower legs with 2 by ¼ in. bolts and large washers, and then fasten the pins in the circular top as at *J*. Add the casters, preferably with rubber tires, and apply felt weather strip around the bottom of the frame.—A. C. SHUMAKER.



How the walker is assembled. The seat is adjusted by means of the two canvas straps

Tiny Oxcart

HOLDS POT OF CACTUS

This miniature Mexican oxcart is an appropriate and picturesque holder for a small cactus plant

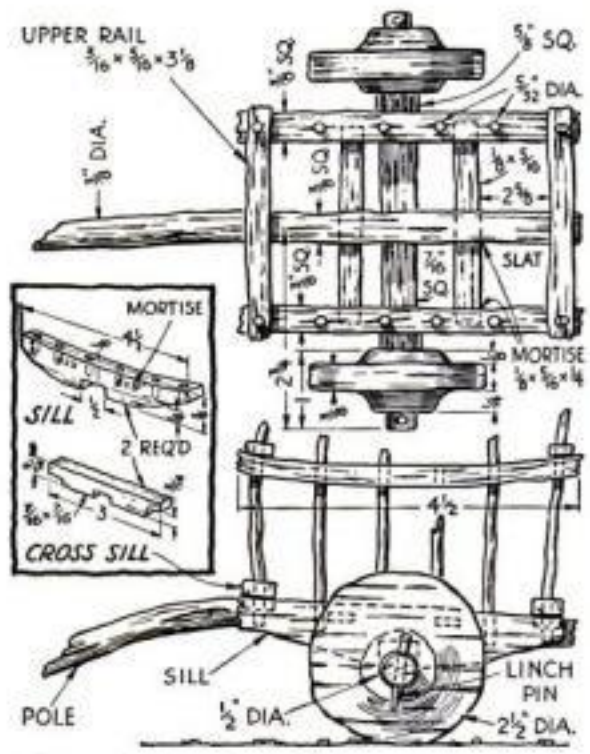
A SMALL potted cactus in a miniature Mexican oxcart forms a unique and decorative gift. The cart illustrated was slashed out on a band saw with only the roughest outlines to follow, but a jig saw would serve as well, or the parts can be easily whittled.

The sills are good starting parts. Notch them accurately for the axle, and hollow the upper edges about ⅛ in. Bore the stake holes clear through. Mortise for the slats, make several crosscuts with a thin saw blade in the ends and underedges to represent checks, and groove deep cracks with a knife or V-chisel, diminishing them toward the centers of the pieces.

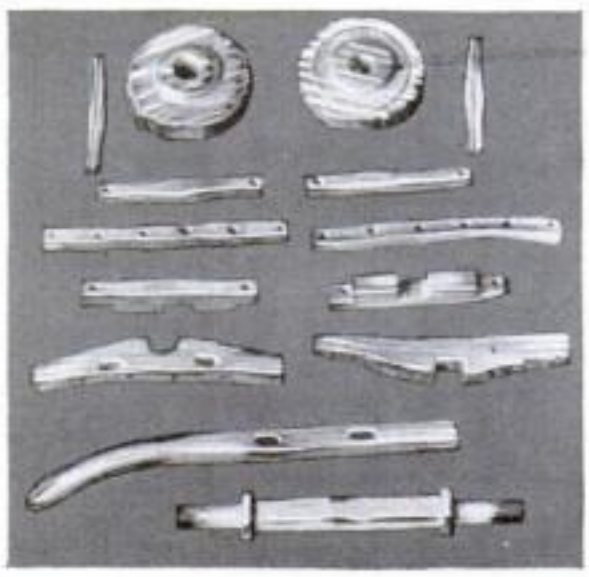
The two cross sills are notched at the ends and center. The pole, representing a tree limb squared along the part entering the cart, is purposely broken off and bent downward to hold the cart nearly level when in use. Mortices are cut through the pole to receive the bottom slats.

Be sure to make the rails irregular. They may bow outward at the centers, as if forced out by long years of hauling dye wood or hides.

The axle is made with a square shoulder behind each journal. The wheels can be turned and afterward sawed and rasped to make them irregular. Remember to flatten them most parallel to the grain. While peeled twigs may be used for stakes, it is quicker to rip out irregular square pine strips, rounding them with a file or on a sanding drum.



Top and side views of the cart, and details of the main lengthwise sills and cross sills



After being roughly shaped, the parts are slightly charred in a flame and wire-brushed

Before assembling, scorch the ends and corners of the parts in a flame, afterward scrubbing them well with a wire brush to remove the char. Brad the main joints from below, and by way of adding realism, bind some of the joints with twine to represent braided rawhide ropes.

For a finish, ordinary brown water-color paint is used as a stain. If, on drying, the tint seems too red or raw, brush on a little dull green. A coat of boiled linseed oil will preserve the wood.—E. M. L.

A MILD BLEACH FOR SPOTTED FLOORS

OXALIC acid has long been used to bleach or whiten discolored wood in its natural finish, especially floors. After applying this chemical, however, the wood is left so white that the spot usually must be stained lightly to restore it to the shade of the surrounding wood. Sodium perborate, which is sold in drug stores for use as a mouth rinse and a tooth powder, is a far milder bleaching agent. Although one may have to rub the moistened powder on the discoloration a longer time than if an oxalic acid solution were used, the after effects are not so conspicuous. Either flavored or unflavored sodium perborate may be used. It is also particularly effective when mixed with equal parts of sodium metasilicate.—R.W.

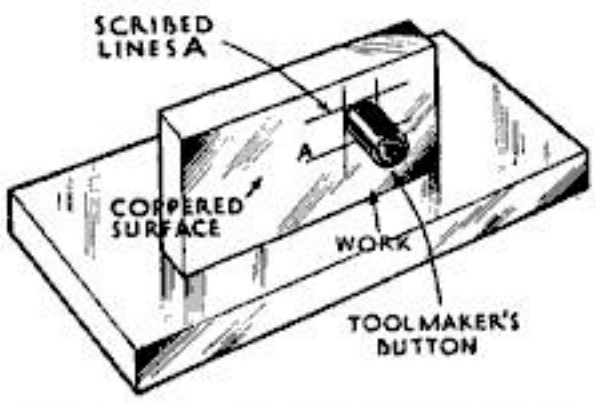
BUILDING A WING CHAIR

(Continued from page 69)

strip of material about 2¼ in. wide will be about right for this purpose, and about 30 ft. will be needed to do the chair and the cushion. The welt is tacked to the very edge on the outside of the wings, to the front of the arms, above the tacking on the material already fastened to the front seat stretcher, and to the rear of the back legs and top of the chair.

The upholstering material may then be cut for the outside of the wings; for the outside of the arms, from the roll down; for the back of the chair; and for the band around the front stretcher. A piece of stiff cardboard is first tacked to the wings on the outside, after which the material is sewed to the welt with a blind stitch. The material must be turned under at the seam. No cardboard is needed at the back of the chair. The narrow band at the bottom of the front stretcher is blind-tacked; that is, the material is turned forward over the tacks holding it to the seat rail. The bottom of the band is tacked to the bottom of the seat rail. Next sew on the material covering the fronts of the arms, using the blind stitch. Making the cushion then completes the chair.

SCRIBED LINES LOCATE TOOLMAKER'S BUTTON



Lines are accurately scribed on the surface, and the button is set with a magnifying glass

WHEN a vernier height gage is used to locate a toolmaker's button accurately, much time is consumed in tapping it around. Even after it is finally located, a toolmaker often wonders if it might not have been accidentally knocked slightly out of place.

The idea illustrated gives a double check. Suppose you are using buttons of .400 in. diameter. With the scriber of the height gage, scribe clear lines on a coppered surface .200 in. each way from the location desired as shown by lines *A*. Then use a magnifying glass to place the button tangent to the lines as shown.

This method is especially useful for locating buttons on irregularly shaped work or round pieces, and gives about the same degree of accuracy as the height gage and indicator method. It is worth mentioning again, that if the work has to be set aside a few days before finishing, there is much satisfaction in being able to recheck.—CLARENCE J. TURCOTTE.

VINEGAR CLEANS BOILER

FOR cleaning and removing scale from inside a house-heating boiler and pipes, I have been using a method that increases the efficiency of the boiler and saves coal. In the fall, after the firing season has begun, I drain all water from the boiler, remove the steam or pressure gage, and, using a funnel, add 5 gal. of bulk vinegar, which is sufficient for the average boiler. The gage is then replaced and the boiler filled with the usual amount of water. This mixture is allowed to remain in the boiler for six days of firing; then the boiler is drained and flushed out thoroughly with clean water.—H. B. KLIMEK.

HAMMERED ASH TRAYS NEST TOGETHER

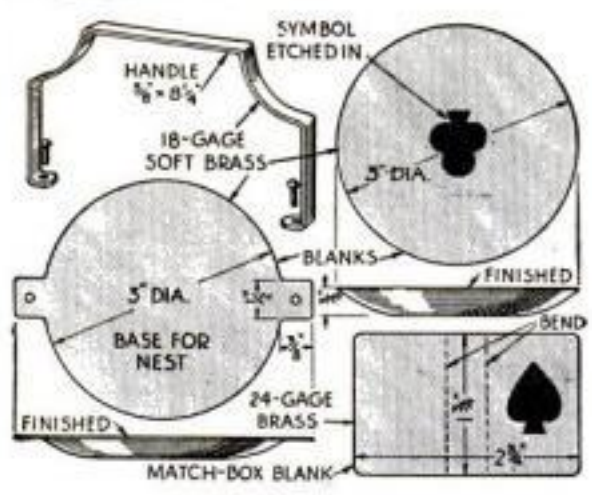
A NEST of decorative hammered ash trays for your bridge table can be made quite easily from 18-gage soft sheet brass. Cut the trays 3 in. in diameter. Hold one of the blanks on a smooth steel block at about a 45-deg. angle and begin hammering about ½ in. in from the edge with the ball end of a ball-peen hammer, driving each blow toward the edge. Cup all the blanks in this way to a depth of about ⅜ in.; then clean up the edges with a file.

Outline one of the symbols of the four suits on each piece, paint all around them with asphaltum, and set the work aside until the asphaltum dries. Etch out the design with commercial nitric acid, remove the asphaltum with kerosene, and paint in the etchings in their respective colors with brushing lacquer.

The base for the nest, which is 3 in. in diameter, is made the same as the trays, except that it is not cupped quite so deep and a lug is left on either side, as shown. The handle, after being cut from the same stock, is bent to shape as indicated and riveted to the lugs on the nest with No. 14 brass escutcheon pins.

The match-box holder is made from 24-gage soft brass, etched and hammered, and bent to shape in the vise.

Complete the set by polishing and lacquering each piece.—J. C. WHITCOMB.

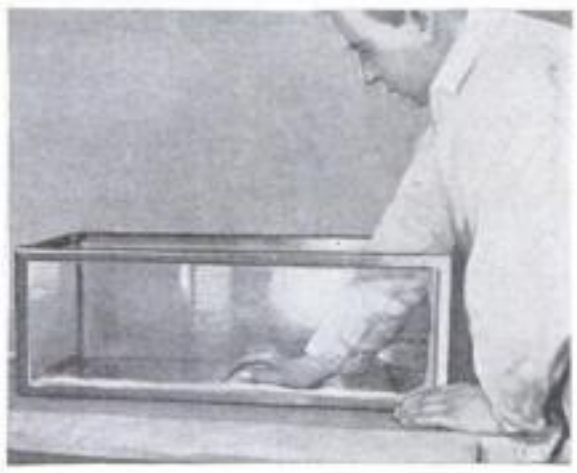


The smoking set partly nested, and drawings of the trays, base, handle, and match-box case

CRYSTALLIZED LAMPS

A NEW crystal finish for electric light bulbs, which has lately become popular for novelty effects in place of the usual "frosting," can be produced by dipping the lamps in a solution of 1 pt. distilled water, 1 oz. of pure dextrine, and as much sulphate of zinc as the solution will dissolve. To this may be added small quantities of aniline dye for giving any desired color, although too much dye will spoil the effect. The crystal finish does not appear until the globes have become thoroughly dry. If they are to be exposed to the weather, give them a thin coat of clear lacquer.—C. L.

GLAZING AN AQUARIUM TO STAY WATER-TIGHT

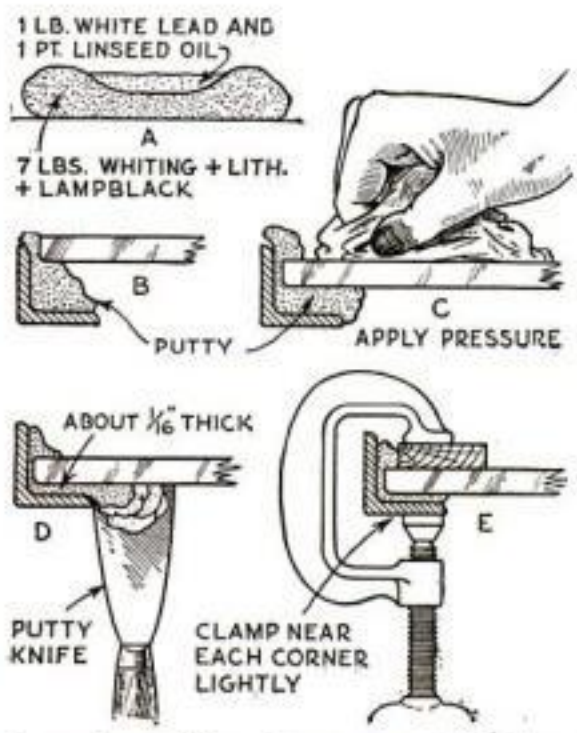


The secret of making aquariums successfully at home is to know how to cement the glass

PLATE glass can be purchased almost as cheaply as window glass in the sizes needed for making an ordinary aquarium. The glass should be cut to allow 1/16 in. of putty space between glass and frame and between glass and glass. For example, if you are glazing a tank that is 10 in. high by 12 in. wide by 24 in. long, inside measurements, and using ¼-in. thick plate glass, the glass sizes used would be as follows: Two side plates (these are installed first) 9⅞ by 23⅞ in.; two end plates (installed next) 9⅞ by 11¼ in.; and one bottom plate (installed last) 11¼ by 23¼ in. If the frame is made so that the metal members overlap, use the smallest inside dimensions in figuring the glass sizes.

The kind of cement used is very important. Experienced fish raisers usually prefer one that will remain plastic indefinitely. Most commercial cements are of this type. You may mix your own of the following ingredients: 10 lbs. whiting, 1 lb. white lead in oil, 1 qt. boiled linseed oil, 1½ tablespoons litharge, and about 1 tablespoon lampblack for coloring gray (if desired). This makes sufficient to set up four or five tanks of the size mentioned above. However, if only one is to be glazed, make up at least twice the amount that you figure will be actually used.

Mix thoroughly about three fourths of the whiting with the litharge and enough lampblack to bring it to the desired shade of gray. Make a mound of the mixture with a depression in the top as indicated at *A*. Now mix separately the white lead with about half the linseed oil and add it gradually to the whiting, mixing the whole mass thoroughly. Add the remainder of *(Continued on page 106)*



Steps in applying the cement. The sides are fastened first, then the ends and bottom

GLAZING AN AQUARIUM

(Continued from page 105)

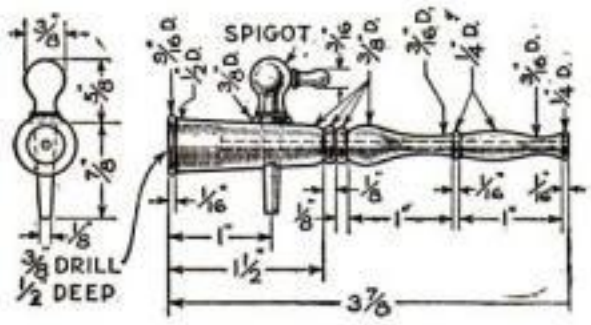
the whiting and linseed oil alternately in small quantities till the cement is a little stiffer than window putty. Pack it in a can to season for several days. Knead thoroughly just before using. Any putty left over may be kept indefinitely by storing it in the can and covering it with oiled paper.

The side plates should be set first. Laying the tank on its side on a firm level surface, fill the angles, as shown at *B*, with putty. Round off the sharp edge of the glass where marked by rubbing it with an oilstone, so that the putty will slide past the corner. Apply pressure by rubbing with a cloth as at *C*, until the putty film is only 1/16 in. thick as at *D*. Scrape away the excess putty. Then, using a small C-clamp as indicated at *E*, clamp the glass lightly at each corner, so the frame may be turned over and the opposite side glazed. The ends are put in next, and the bottom last. Clean off the putty marks, using salt and water, if necessary. Do not use turpentine. Block up the tank on a level surface, fill with water and allow it to set for several days, to test it for leakage. If any develops, the water must be taken out, and the glass wiped dry. The point of leakage will then be easily visible and can probably be repaired by caulking from the outside with a putty knife. If caulking does not stop the leak, the glazing can be done over again without much trouble, if the plastic type of cement has been used.

In painting or otherwise finishing the frame, do not handle it any more than necessary and never in such a way as to twist it out of shape.—Donald A. Price.

MINIATURE FAUCET USED AS CIGARETTE HOLDER

A novel gift for any cigarette smoker is this cigarette holder, which has the appearance of an old-time beer faucet. To make it, a piece of maple ¾ by ¾ by 4¼ in. is needed. Drill a hole 1/16 in. in diameter through the center, and at one end drill a ⅜-in. hole to a depth of ½ in. Make a plug to fit the ⅜-in. hole tightly so that the holder may be turned between lathe centers. Then turn and insert the spigot, and drill the 1/16-in. hole through the spigot. The holder is given a lacquer or shellac finish.—Edwin Putzer.

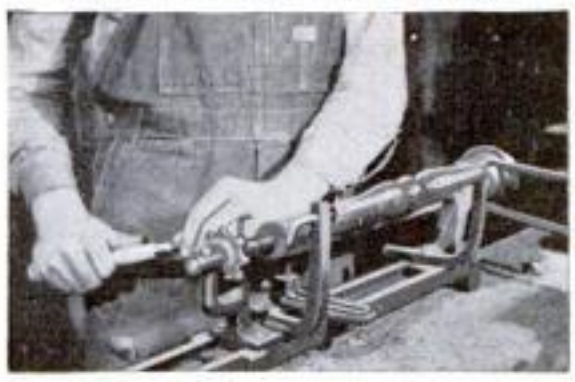


The dimensions of the holder. The hole for the spigot is tapered with a rat-tail file

TAPE HIDES KNIFE CUT IN TABLE OILCLOTH

When table oilcloth is accidentally slit with a bread knife or a carving knife, the cut can be repaired with a strip of surgeon's adhesive tape applied on the underside. If the tape is a little longer than the cut and the edges of the slit are drawn tightly together, the repair will be practically invisible.—R. I.

PATTERN FOR TURNINGS MOUNTED ON LATHE

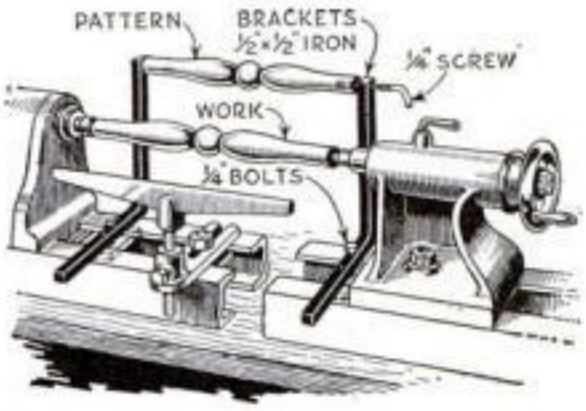


A turned master pattern is mounted directly behind the work to guide in making duplicates

SPEED and accuracy in turning a number of identical wooden parts may be greatly increased by the addition of two simple brackets fastened to the regular lathe bed. These support a turned sample pattern directly back of the rough stock. It is therefore possible for the operator to judge fairly accurately the diameter and design without caliper and ruler, except where the dimensions must be exact.

The shape and size of the brackets will vary with the make and size of lathe. Those shown were bent of ½-in. square rod, with ¼-in. screw adjustments for centering.

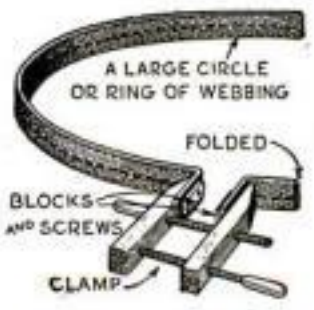
By this method I have turned as many as eight duplicate table legs without noticeable variation.—DONALD R. FOSLER.



How the pattern is set on brackets, which may be of any shape and size to fit the lathe

STRONG WEBBING HELPS IN CLAMPING JOINTS

IN BUILDING furniture that is not rectangular in shape, the problem of clamping is often a difficult one. Recently, while making an octagon-shaped table, I got some furniture webbing, folded it through the center lengthwise, and fastened the ends to a hand screw with blocks and screws, leaving it long enough to reach around the framework when the clamp was open about 8 in. While the glued project is drying, a support should be placed under the clamp to keep it from sagging.—R. PUTZER.



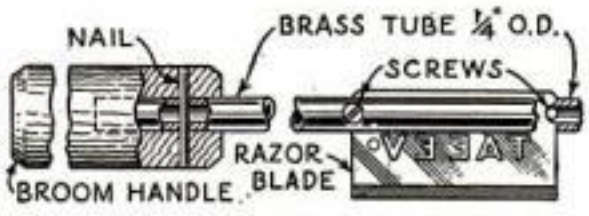
Clamping the framework of an octagonal table with a hand screw and band of heavy webbing

RAZOR-BLADE KNIFE FOR MAKING DEEP CUTS

WHEN making boat or airplane models, a sharp, deep-cutting knife is necessary. Most razor-blade knives will not cut deep enough, but the one illustrated makes a heavy cut with safety. It will split planks to shape for model boats and trim the ends even when working with mahogany.

A 5-in. piece of broom handle is rounded off on the ends and bored 2½ in. deep to receive a 6½-in. length of heavy-walled brass tubing ¼ in. in diameter. Two holes large enough for 6-32 machine screws are drilled through the tubing at one end, spaced exactly 1½ in. on centers.

With a jeweler's saw, split the tube from the end to the back of the second hole, but at right angles to the line of the holes. Now drive the tube into the piece of broom handle. Drill a hole through the handle and tube and drive in a nail. This holder is designed to take a single-edged blade of the type that has two semicircular notches in the ends near the back.—E. F. WALDRON.



How the razor blade is mounted. The tool is 9 in. long over all, and unusually strong

MUSLIN MAILING SACK CATCHES SAWDUST

A CONVENIENT receiver for sawdust from a small circular saw is an ordinary heavy muslin mailing sack, which costs five cents and is equipped with draw strings. Merely slip the mouth over the sawdust chute and tie the strings in a bow knot so that it is easy to remove for emptying when necessary.—K. L. ROBBINS.

To catch sawdust, a muslin mailing sack is tied over the chute of a small circular saw

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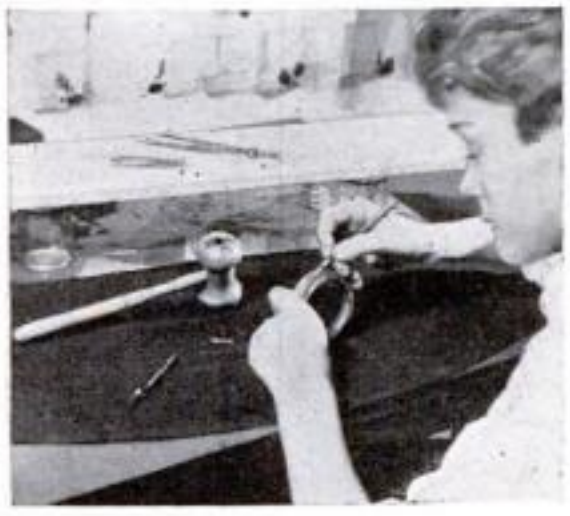
The Index is a complete alphabetical list of all the articles published in Popular Science Monthly during 1934 in reference to woodworking, craftwork, shop methods, house repairs and short cuts, boats, model making, radio, automobiles, electrical apparatus, and such hobbies as photography, chemistry, microscopy, and astronomy. It is a carefully compiled and cross-indexed key to a gold mine of invaluable home workshop reference material. Provided you have kept the twelve issues of 1934, the Index is the one thing needed to enable you to find what you want when you want it. Without the Index, that is a difficult task, because there are almost 400 pages of this type of information in one year's magazines.

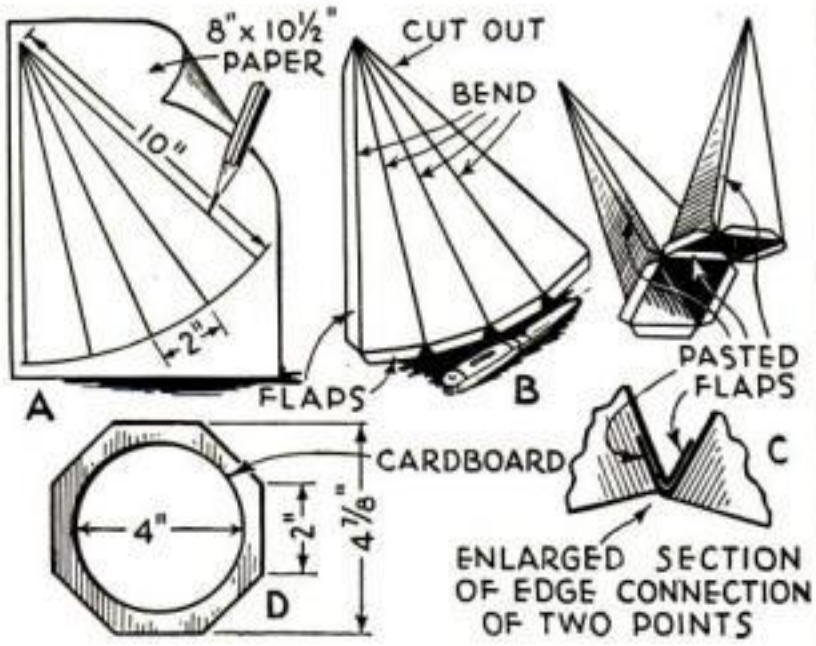
TINY CARVING TOOLS



A HANDY little tool for delicate carving, dry-point engraving, inlaying, and other fine work, may easily be made from the pencil leg of a draftsman's compass and some phonograph needles. The needles may be used as they are or ground to form chisels or gravers. A wooden handle may be fitted, if preferred.

ILLUMINATED *Christmas Star* MADE FROM PAPER

Folded paper star with an electric lamp inside; and, at right, how the individual points are made, and a pattern for the two frames



A MANY - POINTED Christmas star, illuminated inside, can be made from twenty-six sheets of heavy white paper, such as 8 by 10½ in. typewriting paper; a bakelite electric light socket of the kind without a switch, costing ten cents; a 25-watt lamp, several feet of lamp cord, and a plug for the cord.

Lay out and cut a sheet of the paper as shown at *A* and *B*, with tabs about ¼ in. wide on one side and on the bottom of each triangle. Using a straightedge, fold the paper on the four long lines. Then turn it over and fold the four bottom tabs back. Now paste the long side tab to the opposite side to form a pyramid, which is a complete point for the star. Eighteen of these four-sided points are required.

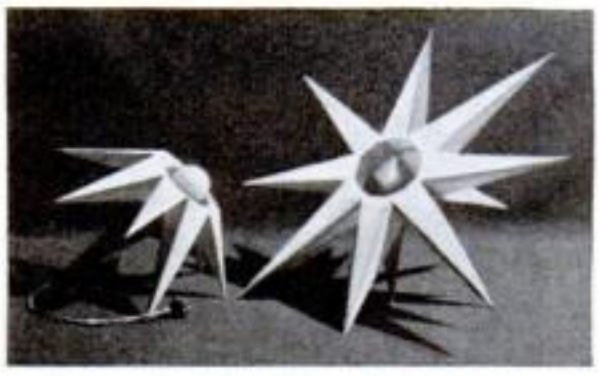
Next make eight points with only three sides. These are the same as the four-sided points except that one of the sides is left off.

The points are fastened together by pasting a bottom tab to the outside of an adjacent point, and then pasting the tab of that side inside of the first point, as shown at *C*. Fasten a four-sided point to each side of a four-sided point to form a cross, and then fasten a three-sided point in each of the four angles of the cross. Make two of these groups. Finally, fasten the remaining eight four-sided points to one of the above groups so as to form a complete circle.

From a sheet of medium cardboard cut out two octagons as shown at *D*. Paste one of these into each of the groups of points, using the remaining tabs.

Splice several feet of lamp cord to the lamp socket, taping the joint well. Open up the tip of the central point of the smaller group of points, and push the wire through from the bottom. Draw the socket up into the point until the lamp hangs about in the middle of the star; then fasten the tip of the point firmly to the wire with adhesive tape or paste and paper, as this forms the only support of the star. Put the plug on the other end of the wire, and make sure that the lamp will burn in the socket. Hang the group of points up and have someone hold the larger group against the smaller while you tie them together by passing a long piece of white grocery cord around the star about four times in different directions.

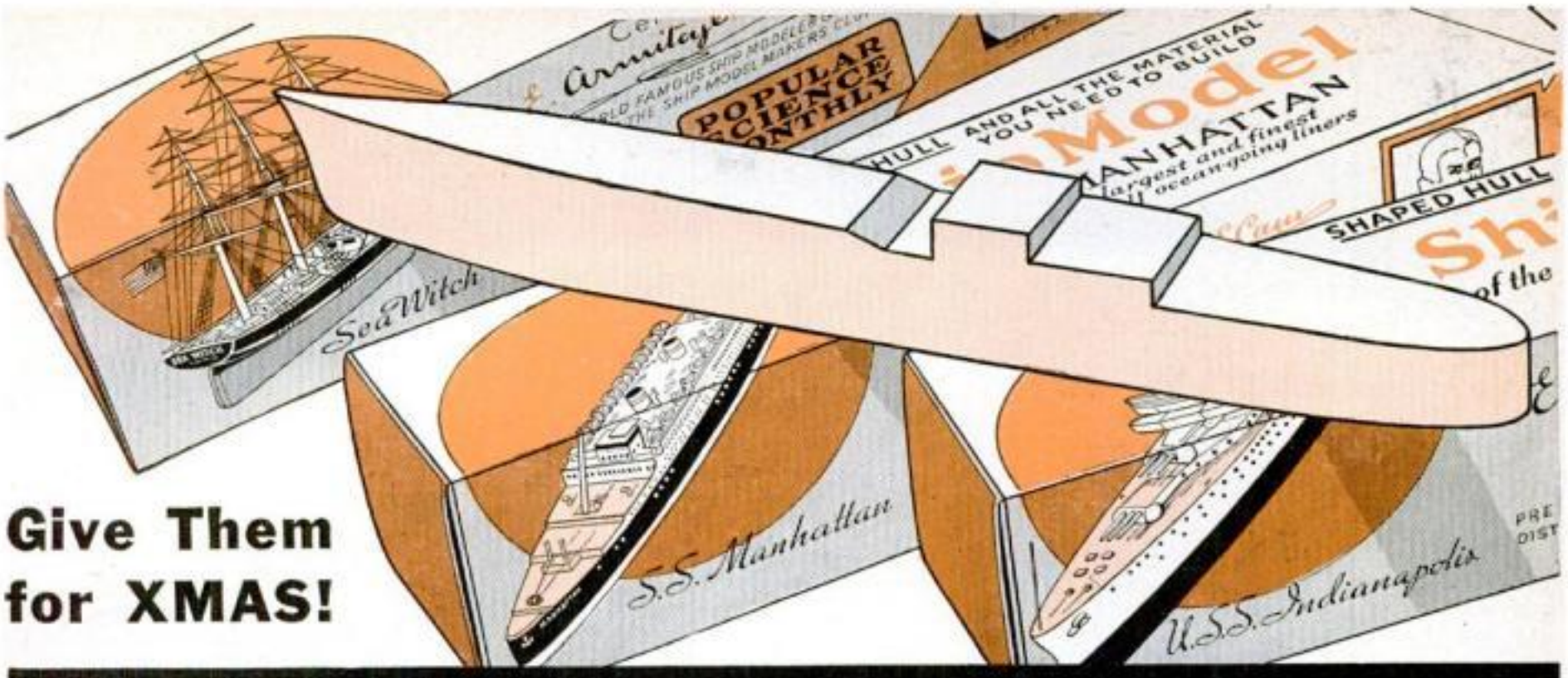
This type of star may be varied in many ways. For instance, the star in the photographs was made by using points of different lengths. Also, colored paper or a colored bulb might be used.—JAMES A. FRANKLIN.



The sections before being tied together. In this case the points are of various lengths

POLISH GIVES GLOSS TO SHOE SOLES

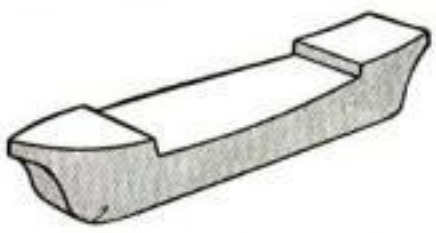
SHOE shining at home can be made more of an art by blackening the edge of the soles of the shoes as well as shining the uppers. A simple varnish-dye for this purpose can be made by dissolving about 8 or 9 grams of borax (a scant half teaspoonful) in 100 cubic centimeters of hot water (about 3 oz.) and adding 12 grams (about half a teaspoonful) of flake shellac. Stir until dissolved. This is used on brown or tan shoes. For black shoes, add about ½ gram (about a pinch) of water soluble nigrosine (aniline black) to the heated shellac-borax solution. The resulting liquid is waterproof.—R. W.



Give Them for XMAS!

BUILD YOUR OWN SHIP MODEL

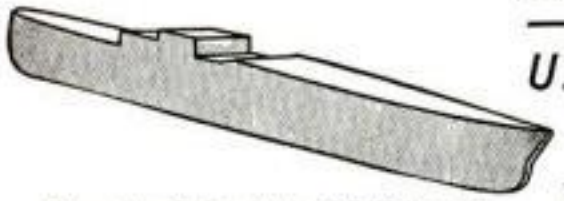
With These New, Improved, Simplified Shaped-Hull Kits



Sugar pine shaped hull—main cuts already made. Easy to finish. Top printed for location of masts, deck houses, etc.

Clipper Ship "Sea Witch" **$1.50** Postpaid

13 inches long—8 inches high. Famous and beautiful American Clipper. Kit contains every part needed including blue print, and pamphlet of instructions. Top deck of shaped hull stamped for location of masts, houses, etc. Kit contains paints, glue, chain, deadeyes, anchors, flags, printed bow and stern name plates. $1.50 delivered.



Almost wholly shaped hull of soft sugar pine with all main cuts already made, easy to finish.

U. S. S. Indianapolis - - - **$1.50** Postpaid

Complete Kit for 12 inch model of the famous cruiser from which Pres. Roosevelt viewed the fleet. An excellent, graceful, racy model, easy to make with simple hand tools. Kit contains everything needed including paints, glue, anchors, propellers, rudder, blue print, pamphlet of step-by-step instructions, etc. $1.50 postpaid.

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Everything you need to make a 12 inch model of this largest and finest American built liner. A sharp pocket knife is practically the only tool you need. Kit contains paints, glue, blue print, pamphlet of instructions, 40 completely finished life-boat davits, 2 propellers, 2 anchors, 1 rudder. All main cuts in the sugar pine hull already made.

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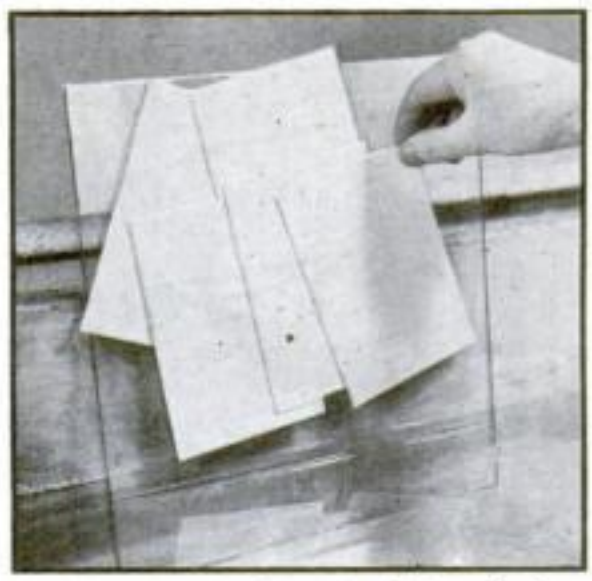
PHOTO PRINTS DRAINED ON SHEET OF GLASS



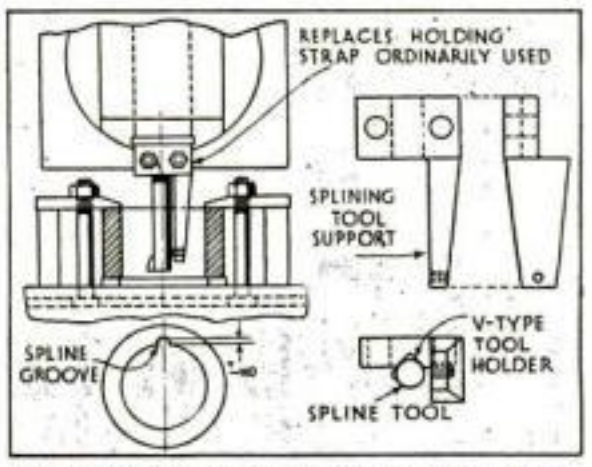
As they are taken from the fixing solution, prints are rested against the glass to drain

WHEN many photographs are developed at one time, it is convenient to rest a sheet of glass, about 15 in. square, against the inside of the tank containing the fixing solution. The fixed prints can then be laid against the glass, where they will adhere and drain before washing. The glass is also useful for keeping fixed prints separated from those newly placed in the hypo.—K. L. R.

SPLINING TOOL SUPPORT FOR ACCURATE WORK

EXCEPTIONALLY accurate splining can be done if the tool is prevented from springing by the use of a special support made as shown. This was designed for a commonly used type of splining attachment which has a V-type tool holder. The original strap is removed and the tool support attached in its place.

With a splining tool supported in this way, a number of serrated internal taper gages



The splining tool is prevented from springing by a support directly behind the cutter

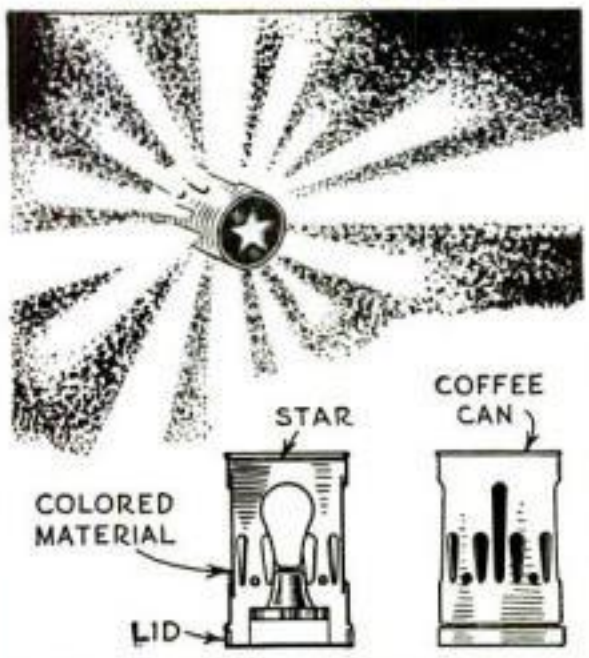
were made for gaging propeller hubs on a certain make of airplane. Since no method was known by which a gage of this type could be ground, its accuracy had to depend entirely on the splining operation. There was too much give to the tool, however, and consequently the gage was left bellmouthed and the serrations were inaccurately spaced. After the tool support was employed, each gage was found to be correct as to taper and spacing when checked with the external gage which had been ground with the greatest care to a precision of .0002 in.—CARL O. KLOCKARS.

RE-ENFORCING WINDOW SHADES

APPLYING a strip of thin adhesive tape to the upper edge of a window shade before it is tacked on the roller will prevent it from being torn off. White tape suitable for this purpose is inexpensive and easily obtained.

CHRISTMAS LIGHTING

(Continued from page 75)



A decorative pattern of colored light can be played on a wall by using tin-can shields

sides of the can with an old knife or similar tool. Do not make the openings too wide. A star or other design can be punched in the can bottom. A combination of several of these units can be arranged.

Among this year's new Christmas lighting equipment is a multiple-string bulb for tree lighting and for festoon decorations. It replaces the series string of eight lamps formerly used, and has the advantage that when one bulb burns out the remainder do not become extinguished. The multiple bulb is known as the C-7½ Mazda, multiple-burning lamp.

Several inexpensive outdoor lighting displays have been suggested by Robert L. Zahour, a Bloomfield, N. J., illuminating engineer. His method of making a star is to combine three multiple-type Christmas tree strings of seven lamps each. On an old table top or other surface into which nails can be driven, lay out a circle 28 in. in diameter. Divide the circle into five equal parts, and drive spikes. Draw lines connecting alternate points and drive spikes at the points marked 2, 4, 6, 8, 10 in the drawing of the completed star. A wire frame may be bent around these if desired, although for most purposes it will be found that the star holds its shape well enough without a frame. Fasten one of the end sockets of the first lamp string by tying the socket to spike 1 with a length of wire or string. Then continue to points 2, 3, 4, 5, etc., in succession, tying the sockets to the spikes. When the end of one lamp string is reached, connect the wires to the end of another string, and continue in accordance with the numbers as before. When the star form is complete, bind the wire strands between sockets with friction tape. The spikes may then be pulled out and the star removed.

Construction of a luminous wreath is a simple matter. Sockets for green S-11 or C-9½ lamps are arranged in a circle and supported by a wire hoop to which they are fastened with friction tape. The current-carrying wires can be brought together at the center and connected to a flexible electric cord.

Luminous candles mounted on either side of an entrance are particularly effective. The candle proper is formed by bending a strip of red screen-wire gelatin (flexible glass substitute) so that it assumes a half-round form. This material, of course, must be reasonably heat resistant and fireproof. The edges are tacked to a wood strip 5 or 6 in. wide and 4 or 5 ft. long. Along the center of this strip are mounted sign sockets to receive 40-watt tubular lamps or white-frosted 25-watt, T-6½ lamps. At the top of the candle structure is a medium screw (Continued on page 114)

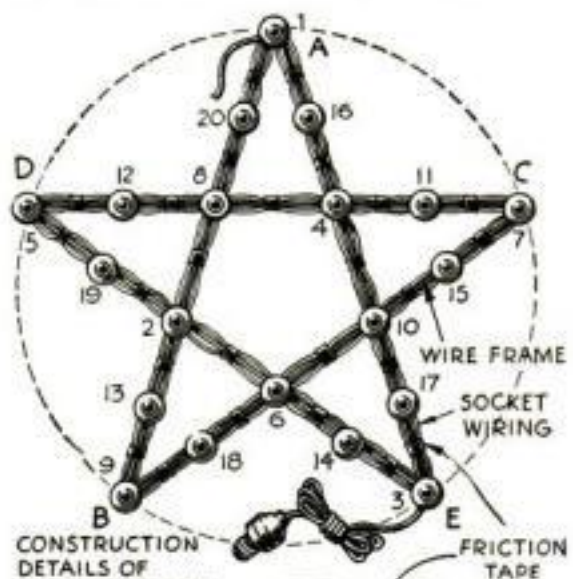
CHRISTMAS LIGHTING

(Continued from page 113)

socket for a 25-watt, F-15 flame-tint lamp.

Another effective ornament, for use at the ends of illuminated festoons, the peaks of gable ends, and the like, is a luminous bell. This is made by covering, with red-lacquered parchment or colored cloth, a wire bridge lamp shade frame that is shaped like a bell sliced in two. An ordinary 25-watt lamp is suspended inside the shade.

Window shutters of the solid type, with cut-out designs, may be illuminated by placing small lamps behind the openings.



Suggestions for a luminous star, wreath, and bell, and method of constructing big candles

WORN-OUT PAINTBRUSHES RESHAPED BY GRINDING

OLD paintbrushes, particularly the kind known as sash tools, can be pointed up or trimmed on a grinding wheel if the bristles are first dipped in glue and allowed to dry hard. The glue is soaked out afterwards by placing the bristles in warm water.

SIMPLIFIED TESLA COIL

(Continued from page 66)

rig. The latter may be constructed in a few moments with the aid of a small vise, hand drill, curtain rod, four brads, and two pieces of wood, arranged as shown. The brads are spaced far enough apart to fit the inside of the tube snugly. If the holes in the middle of the end pieces fit the rod tightly enough, the tube will be held securely by friction. The end of the rod may be supported in any convenient way to steady it, if necessary.

Before winding, give the tube another coat of varnish, and begin when this is still tacky. Puncture a small hole ½ in. from the left end of the tube, and pass about 6 in. of the No. 28 wire through it. Then wind a single layer of wire from that point to a point ½ in. from the other end, bringing the final end of the wire out through a tiny hole as at the beginning. It is best to apply a coat of varnish to the tube immediately ahead of each 2 or 3 in. of winding, so that the underside will be permeated. When completed, the outside should be given two coats.

The assembly is clearly shown in the drawings and photographs. The lower end of the secondary winding should be connected under the head of the bolt that secures the binding post on the inner turn of the primary. The upper end should be secured to the bolt on which the bed ball is screwed. Make these leads as short as possible.

With coil and exciting apparatus completed, you need merely connect them up and adjust them. Few precautions are necessary, except that one should keep from touching any part of the exciting circuit while the coil is in operation. Always open the switch before making adjustments of the spark gap, condenser, or tuning coil. Although the current from the secondary of the Tesla coil is absolutely harmless and almost without sensation, the current from the exciting circuit may give one an unpleasant jolt.

To get the longest and heaviest spark from a Tesla coil, it must be tuned and otherwise adjusted as carefully as a radio transmitter. The finer the apparatus used, the more precisely it must be adjusted, so experiment patiently to find the most effective adjustments of the spark gap and tuning coil. With one adjustment of the clip of the tuning coil, you may get no spark at all; by moving the clip merely half a turn, a 4-in. streamer may dart from the ball of the Tesla coil, and another quarter turn may double this.

BUBBLES OF ROSIN FORM ARTIFICIAL SNOW

ARTIFICIAL snow, which is many times more sparkling and brilliant than the usual flakes of mica used for the purpose, can easily be made with ordinary lump rosin. Melt a few lumps in a small can cover. When it is of the consistency of thick molasses, pick up some on the end of a soda straw and blow gently to produce brilliant bubbles of many sizes and shapes. After making a sufficient quantity, crush them up into small flakes.—G. G.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

WINS WORLD-WIDE FAME WITH MICROSCOPE HOBBY

(Continued from page 26)

that takes place unseen within the human body when the blood corpuscles battle to the death with germs of infection. Three months went into the making of this film, 5,000 feet being exposed to obtain the final 500 used.

The hardest work Gravelle encounters is in taking pictures of the particles of a colloid solution. Before he can begin shooting, he has to disperse them in a film hardly thicker than the particles themselves. These bits of matter, whirling on microscopic orbits, are constantly in motion. This allows an exposure of only one twenty-fifth of a second although the particles are "kicked up" to a magnification of 1,500 diameters.

RARELY does he go beyond 1,500 diameters. Above it, he says, you get only "empty magnification." That is, you pull the lines a little further apart but obtain no additional detail. Incidentally, magnification refers to the number of times the *diameter* of an object is increased, not its *area*. An object magnified 1,000 diameters, increases in area 1,000,000 times. Older microscopists used to give the latter figure as it sounded more spectacular.

As Gravelle's apparatus accumulated, it became scattered all over the house. Finally, it was crowding out the furniture. Two and a half years ago, when building materials were at their lowest cost, he was able to realize a dream he had had for years. He built a laboratory addition to his home, a long room thirty-five by fifteen feet, extending into the garden.

In planning this ideal workroom, he first drew a floor plan to scale and then marked out, also in scale, all the pieces of apparatus that would have to go in the room. When he finished, he discovered the equipment was going to fill all the space and leave no place in which to walk around! So he had to extend the addition, increasing its length ten feet and its width five. The cost of the building was about $4,500. With the equipment it contains, it is valued at $20,000.

As you approach the laboratory, you pass from the living room of his home into a scientific library containing more than 3,500 volumes. Complete files of all the microscopical magazines run back to 1868. Practically every book on the microscope ever published is there. And cabinets along one wall hold thousands of microscopic slides for tests and comparison. No two are alike and they cover a wide range of scientific fields.

Beyond the library, you enter the workshop, a room filled with electric-driven machinery, lathes, drills, precision grinding wheels. There are jeweler's hacksaws and cabinets packed with assorted tools. At one side, shelves hold bottles of chemicals, and below, a freezing outfit enables Gravelle to prepare specimens for slicing with a minimum of delay.

IN THIS workshop, some of the most effective apparatus he uses was designed and built. For instance, the vertical photomicrographic camera with which most of his work is done, is of his own design. It has a window in the side which enables him to focus on the ground glass much in the manner of a photographer using a reflex camera. Other products of the home workshop are an infinite variety of specimen holders and original gadgets for examining various materials.

When you ascend a step into the next room, you find yourself in the laboratory proper. Lines of instruments like three black windrows run the length of the room, two along the walls, one down the center. There are a dozen microscopes, costing from $300 to $1,000 apiece. *(Continued on page 117)*

WINS WORLD-WIDE FAME WITH MICROSCOPE HOBBY

(Continued from page 116)

There are plate cameras, reflex cameras, view cameras, stereoscopic cameras, movie cameras. There are polarized light outfits, ultra-violet light machines, cabinets of auxiliary lenses, shelves of stains for specimens, tables that wind up and down like barber's chairs. For throwing pictures on the white wall which forms a screen at the far end of the room, there are still and movie projectors.

ONE of the super-delicate machines which makes fine work possible is a microtome clicer. Each notch of its wheel represents 1/25,000th of an inch, increasing or decreasing the thickness of a section that much according to which way the wheel is turned. Razors, made of special steel and costing from $10 to $27 apiece, do the cutting. They are honed in unique racks to the finest cutting edge. The least dullness will pull delicate specimens apart.

I asked Gravelle how many pieces of apparatus he had. He answered honestly that he doesn't know.

At the far end of the laboratory is the darkroom. Fifteen by nine feet, it contains enlargers, contact printers, ferrotype racks, an electric fan that goes on automatically when the window is opened, chemicals, films, electric clocks, twelve kinds of darkroom lights, and even a radio that stutters when the front doorbell rings. Thus if Gravelle or Howard Somers, his assistant, are working alone in the room, they can tell if callers are at the door even if the radio is going.

About a year ago, the men were working late one night when they ran into difficulties which even their elaborate equipment was not prepared to meet. Turning on the water, they saw white sudsy liquid pour from the faucet. The water works, they learned later, had selected that late hour when few people would be using the water supply to dump in purifying chemicals. Afterwards, Gravelle avoided that hour in developing and printing.

In 1924, less than ten years after he had looked through his first microscope, Gravelle was awarded the honor coveted by every photomicroscopist in the world, the Barnard Medal of the London Photomicrographic Society. Eight slides, together with the magnifications at which they are to be reproduced, are sent to each competitor for the medal. These magnifications run from two to 1,500 diameters. Each contestant gets the same slides, holds them two weeks and then sends them on to the next competitor. Gravelle sent them on to a man in Alberta, Canada. From there they went to another microscopist in Australia.

In this world-wide competition, the judges who examined the slides by arc light in London, selected Gravelle's work as the best. He was awarded the bronze medal with the diatom on its face which is symbolic of the highest achievement in photomicroscopy. It was the first time the medal was awarded outside of England and it is still the only time an American received it.

BESIDES his Fellowships in the Royal Microscopical Society and the Royal Photographic Society, Gravelle has been a Fellow of the New York Microscopical Society since 1919. He is also a member of the Queckett Microscopical Society, the American Microscopical Society, and the London Photomicrographic Society.

In the thrill of exploring the unseen and bringing back snapshots of the wonders it contains, he has found enduring satisfaction as well as achievement and honors. Seventeen years ago, he put on the magic glasses of the microscope. And he has been wearing them, entranced, ever since.

INDUSTRY ON THE MOVE

INDUSTRY is on the move; the pace becomes faster and faster. Never before have so many revolutionary ideas been forthcoming. Tomorrow, we may awaken to find an entire industry changed, almost beyond recognition. How little resemblance the latest model automobile bears to the car of a few years ago. How dissimilar the proposed all-steel house of tomorrow will be, compared to the present conventional design.

This constantly shifting picture affords many opportunities to the man who can see ahead. Even now there are industrial innovations about to blossom forth into wide-scale use. There is a new process for fabricating steel structures by welding; air-conditioned houses are already appearing; television is rapidly approaching the standard of commercial requirements. The complete list would be both lengthy and impressive, if it were available, but many ideas are being discreetly hidden from the public eye.

The man with a background of study and training in any one of the many branches of industry has an ever widening scope of activity. When commercial aviation gets into full swing, for instance, there will be a shortage of men in several of its technical branches. What an age this is for the man who keeps in step with the procession.

Perhaps the most encouraging aspect of this age of rapid progression is the possibility of men being trained for new lines of work when their present occupations become outmoded. Fortunately, the system of technical education is moving forward at a pace equally as rapid as that of inventive genius. One has but to keep his eyes open to see opportunities in the near future that will surpass anything we have experienced.

• • •

HE TURNED SCULPTOR

AN UNEMPLOYED interior decorator was walking along the beach one day, wondering where his next meal was coming from. As he stared at a high sand bluff, an idea formed in his mind and he hastened to the city council chamber of the town. Luckily, the council was in session and he was permitted to outline his plan.

With breathless enthusiasm, he pictured the impressive *(Continued on page 119)*

Secrets of Success

HE TURNED SCULPTOR

(Continued from page 118)

spectacle of a huge head of Theodore Roosevelt, modeled in cement, high on the cliff. The city fathers were impressed by the unique idea but stroked their chins as they pondered over the probable cost. But the intrepid decorator was as practical as he was artistic. All that was needed, he explained, was a few tons of cement; he would not even require any special tools. His enthusiasm won the day.

With only three tools—an axe, a pick-axe, and a piece of tin with which to model—he started to work, with his young son as a helper. As though by magic, the rugged features of the great rough rider took form. People came from near and far to see the strange performance. In four days the work was finished. The councilmen were delighted. The citizens came, admired, and left behind them tokens of their appreciation in the form of voluntary cash contributions. The resourceful decorator found himself with money in his pocket for the first time in months. But he was not through.

Other beach towns have since signed contracts for the modeling of likenesses of national heroes on mountainsides and bluffs. Since his first venture he has not been dependent on voluntary contributions. He now receives substantial fees from the municipalities and is once more happily employed.—J.S.M., Maplewood, Calif.

• • •

IT STARTED FROM DUST

BILL was trudging along a hot, dusty road on his way to the soft-ball diamond on the edge of Canon City, Colorado. As the cars streamed by, huge clouds of dust choked him and almost blinded him. But Bill was too busy thinking to complain. He was thinking about that dusty road. The weather had been hot and dry; the popularity of the soft-ball park was causing a steady increase in traffic. To make matters worse, there was a water shortage which made sprinkling impractical.

An idea was struggling into shape in Bill's mind. He had talked, that very day, with irate residents along the road, who were "fed up" with the almost unbearable condition. Oiling the road would cost at least five thousand dollars a mile, according to the highway department's figures. That was not in the cards. But why should the cost be so high?

Materials—that was the catch. Why couldn't some cheap substitute be used? Bill jumped for *(Continued on page 120)*

Secrets of Success

IT STARTED FROM DUST

(Continued from page 119)

the gutter as a car whizzed by. Blue clouds of exhaust smoke mingled with the dust. An oil-pumper, Bill said to himself. An oil-pumper—oil—that was the answer! Just plain crankcase oil was the very thing.

Bill forgot the soft-ball game. It didn't take him three minutes to reach the nearest filling station. When he walked out he carried with him an option on all their old crank-case oil. One by one, he canvassed all the filling stations. When he finished he had signed practically every one in town.

The next step was to purchase an old truck. He got one at a ridiculously low price. Being handy with tools, he soon had a home-made sprinkling truck rigged up. He started out after business. His price was a dollar for oiling the road in front of a house. The residents welcomed the chance to get a dust-proof coating for such a small fee. Business became so brisk that he soon found the supply of crank-case oil inadequate.

Bill had no intention of allowing this shortage to limit his business. He made a deal with the refineries at Florence to supply him with crude oil. But when he tried to use it, it was too heavy. It wouldn't flow. Again Bill used his ingenuity. He installed a heating tank on his truck and went merrily on his way. The city council, by this time unable to cope with the water shortage, engaged him to oil the roads in front of vacant property.

Bill is back in college now—thanks to his earnings—but you can rest assured that next summer will find him atop his home-made sprinkler.—A.D.P., Denver, Colo.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

HERE'S THE ANSWER

(Continued from page 63)

Knife-Handle Cement

W. R., ST. PAUL, MINN. A hard-setting cement for fastening knife blades in their handles can be made easily by boiling together caustic soda (one part), rosin (three parts), and water (five parts); finally adding plaster of Paris (four parts). The cement should be used immediately and cannot be saved.

Master of the Bush

H. B., BUFFALO, N. Y. The Mapepire, or Bushmaster as it is more often called, is one of the most poisonous of snakes. Often growing to a length of eleven or twelve feet, it develops long fangs capable of inflicting wounds that may cause death in a few minutes time. It is an egg-laying reptile found principally in Central and tropical South America.

Removing Rust from Tools

F. D., DAVENPORT, IOWA. Small rust spots on instruments, tools, and delicate metal parts generally can be removed with a solution made by dissolving a teaspoonful of ammonium citrate in a quart of hot water. Rinse the objects thoroughly before and after applying the liquid. Finally, dry the surface with heat.

Lightning's Power

C. D. S., WILMINGTON, DEL. Lightning striking a metal structure or a lightning rod may produce a current as high as 60,000 amperes. In the instant of the flash, enough power is dissipated to light 130,000 fifty-watt lamps.

Wants Motor in Vacuum

A. L., MAHANOY CITY, PA. Theoretically, both electric generators and electric motors will operate in a vacuum. Practically, however, there will be undue overheating caused by the lack of circulating air.

Ship's Hull Like Battery

D. T., PORTLAND, ORE. Some ships are sheathed in zinc at the stern to protect their hulls from the electrolytic action of the salt water on the steel of the ship and the manganese-bronze propeller. Manganese bronze is used for propellers because it will bend and dent without snapping.

In the Dark About Cats

Q.—IS IT true that cats can see in the dark? —J. K. L., Baltimore, Md.

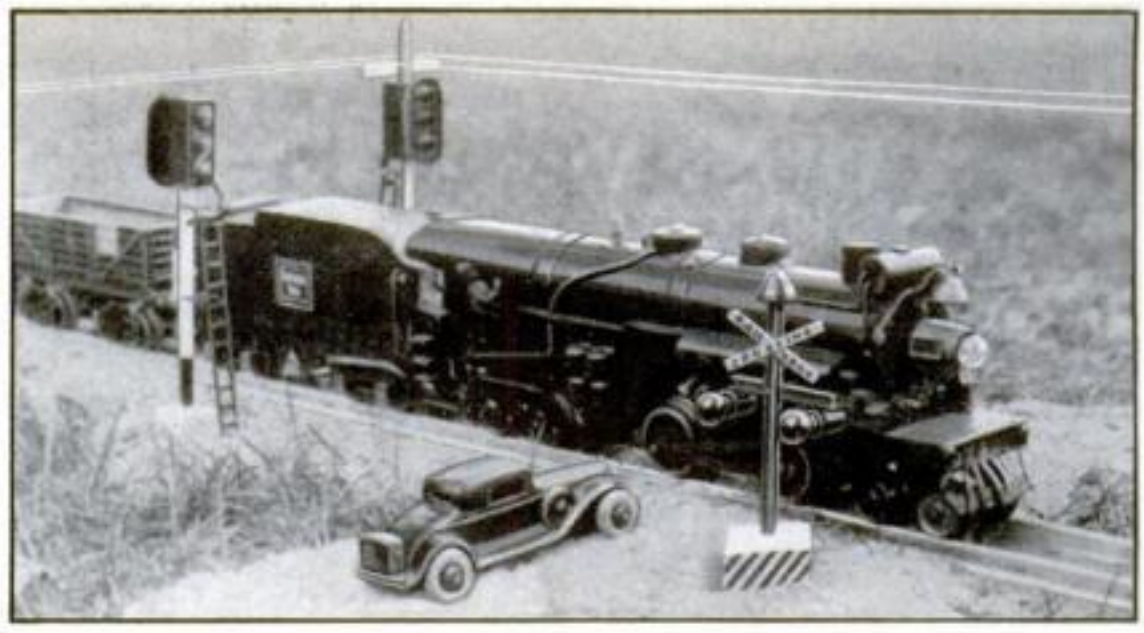
A.—Not exactly. Although they can see better than man in a moderately dark room, their eyes, like man's, are useless in absolute darkness. They require some light even though it may be small.

Venus Beats Out Mars

H. G., PHILADELPHIA, PA. According to the latest reports from scientists and astronomers, Venus, not Mars, is the most probable home of life on other planets. It has been estimated that the temperature on Mars drops to at least forty below zero at night.

Short or Long Pants?

E. T., BOSTON, MASS. Although our lungs can hold about ten pints of air they are filled only when we take a deep breath. Under normal conditions they hold about six pints, one pint being breathed in and out every time we take a breath.



Highway Flasher Signal

ADDS REALISM TO MODEL RAILWAY

A WELL-DESIGNED model railroad usually includes at least one highway crossing at grade, which, in line with modern railroad practice, should be automatically protected. The accompanying drawings show a flasher signal for an "O" gage railroad. The pole consists of a piece of ¼-in. outside diameter brass tubing cut to a length of 3¾ in. The cross arm is a piece of 3/16-in. square brass rod 1⅝ in. long. This is bolted to the pole at a height of 2⅝ in. from the bottom. Two socket shells are soldered on the underside of the cross arm, pointing at right angles from the arm. These shells may be obtained by taking apart miniature porcelain-base sockets, or may be purchased at some electrical supply dealers. The lamps are miniature flash-light bulbs painted with two coats of vermilion lacquer or enamel. A smooth, even coat may be put on if the bulbs are kept alight while being painted.

The foundation of the signal is diamond shaped. A notch is cut in the pole ⅜ in. from the bottom, and a 3/16-in. hole is drilled through one side of the foundation to correspond in position with this notch. The wiring from the lamps then may be run inside the pole and out through the side of the foundation. If the builder prefers, the wiring may be run directly out through the bottom of the pole provided connections can be made under the baseboard of the track. The foundation is fastened beside the track with wood screws.

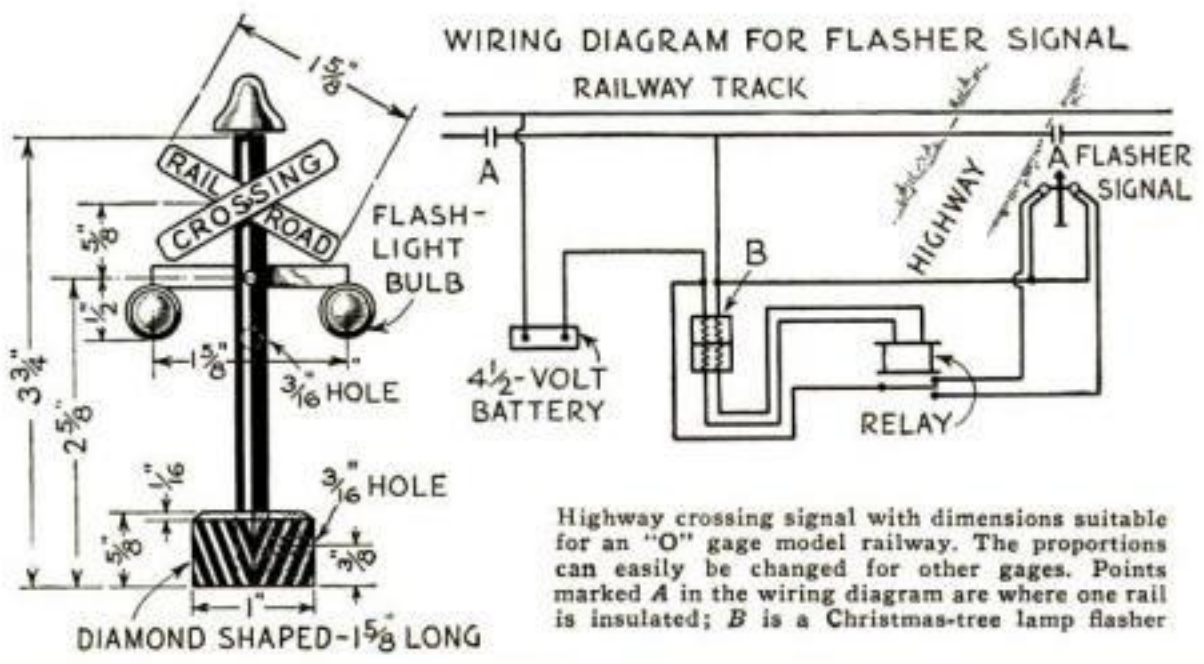
A 3/16-in. hole should be drilled in the back of the pole ½ in. below the cross arm. This is for the wires to enter the pole from the lamps. Radio "spaghetti" tubing should be used to inclose the wires where they enter and leave the pole. This gives the effect of "flexiduct" tubing used by railroads under similar conditions.

A crossing sign may be included on the pole. It should be fastened ⅝ in. above the cross arm. The sign should be made of 20-gage brass cut ¼ in. wide and 1⅝ in. long. The two pieces are drilled in the center and bolted to the pole with a 2-56 machine screw. Either a pinnacle or a dummy bell may be added as a finishing touch at the top of the pole.

The base is painted white to imitate concrete and has diagonal black stripes on all sides. The pole, cross arm, sockets, and pinnacle are painted black, while the sign is painted white with the words "RAILROAD CROSSING" printed in black.

Three wires are necessary, one to each lamp and a common wire fastened to the pole, preferably under the bolt holding the cross arm in place.

As shown in the wiring diagram, one running rail of the track is insulated at points *A*. One of these points should be right at the highway crossing, while the other is at a sufficient distance so that the flasher will give a realistic warning of a train's approach. *B* is a thermal flasher device used for making Christmas-tree lights blink. It is of the type that screws into a miniature socket, and itself includes another socket of the same type. It should be mounted by screwing it into a porcelain-base socket connected as shown. Two

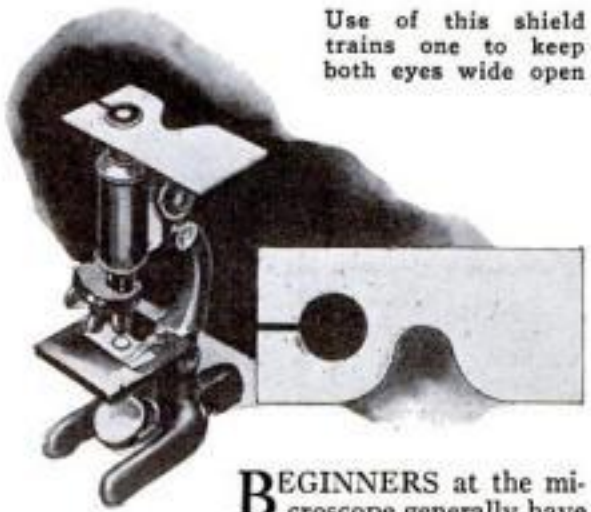


Highway crossing signal with dimensions suitable for an "O" gage model railway. The proportions can easily be changed for other gages. Points marked *A* in the wiring diagram are where one rail is insulated; *B* is a Christmas-tree lamp flasher

wires are fastened to the outlet or socket end of the blinker, preferably by soldering. If difficulty is experienced in reaching the center contact to solder the connection, the same results may be obtained by carefully breaking the glass of an old flashlight bulb and soldering the two wires directly to the filament leads therein. This may then be screwed into the blinker socket. This done, it is necessary only to run the wires to the relay and flasher signal.

A train passing the insulated joint makes a connection between the two running rails. This completes the circuit and allows the battery current to flow into the blinker, which causes the relay to open and close at regular intervals. The light circuit is wired through the relay and track so that when no train is on the section, neither lamp is lit. However, with a train approaching, the lights will alternate as the relay opens and closes, giving the same blinking effect as a standard crossing signal.—T. W. TIZZARD.

MICROSCOPE EYE SHIELD AIDS BEGINNERS



Use of this shield trains one to keep both eyes wide open

BEGINNERS at the microscope generally have trouble in seeing the object without closing one eye, a procedure which places an unnecessary strain on the eyes. An eye shield remedies this, although you should accustom yourself by practise to keep both eyes open without the shield. Cut the shield out of any lightweight cardboard. Make it a rather tight fit on the body or draw tube of the microscope.—C. G. GROVER.

ROUNDHEAD SCREW USED IN DRILLING GLASS

HAVE you ever tried drilling a hole in glass? The usual methods are discouraging, but the process illustrated eliminates breakage and provides very close control of the size and shape of the hole.

The necessary equipment includes a drill press, a steel roundhead machine or wood screw having the head diameter the same as the size of the required hole, and a little coarse valve-grinding compound. Place a very small quantity of the abrasive on the head of the screw; then bring the revolving head head down onto the glass, being sure that the glass is held so it will not slip. The slot in the head of the screw helps hold the abrasive, and after running a little, the depression in the glass develops with a tiny point raised in its center, which aids in keeping the drill centered. Best results will be obtained if very little pressure is applied in feeding the drill.—MARCUS D. WEEKS, JR.

Set-up for grinding small holes in glass

HOW MASTER CRIMINALS ARE TRAPPED BY SINGLE FINGER PRINTS

(Continued from page 19)

surface the killer might have touched. Finally, while brushing the inside of the closet door, he found a print invisible to the eye. He pressed the muzzle of his camera hard against the surface and shot. Next day the print was broadcast throughout the country.

Every month searchers compared the print with others in the files, but without result. Three years later, a sailor was arrested for robbery. While making a periodic comparison of prints, a searcher came upon one which matched the sailor's right index. The prints were enlarged and carefully examined. They proved beyond doubt his presence in the murder room.

FINGER-PRINT experts working under Captain Barlow's directions make use of all known scientific aids in detecting, developing, and photographing chance prints. Those found on dark backgrounds, such as a mahogany table, are "brought out" in contrast by a gray powder, a mixture of mercury and chalk, lightly brushed over the surface. For prints on light objects, Captain Barlow uses what he terms a "magic black powder," mixed in the police laboratories from seven parts of lamp black, two of powdered graphite and one of acacia powder. The acacia causes the compound to fluff up and keep dry.

After the print is developed in this way, it is photographed by a fixed-focus camera, held flush against the surface. Four lights within the front four corners of the camera illuminate the print. Prints on glass are dusted with light powder, then photographed against a backing of black paper.

Legal delays frequently necessitate the preservation of evidence for presentation to juries. Finger prints on glass are made permanent by flowing lantern-slide varnish over them, or etching by the fumes of hydrofluoric acid, which eat away the glass between the greasy ridges to leave a permanent print. When not prepared in this manner, they are protected by small pieces of transparent film fastened down by tape.

A simple trick makes possible the photographing of prints on mirrors, despite the normal reflection of the lights. Some time ago a diamond salesman carrying $125,000 worth of precious stones was held up and his car taken. When the abandoned car was recovered a lone print was discovered on the rear-view mirror. The police photographer dusted the print with light powder, blocked out the remaining area with printer's ink to kill the reflection and took his picture without difficulty. By comparison with prints in the file, the duplicate was found. The suspect, when arrested, confessed.

OFTEN movable objects bearing prints are brought to police headquarters for direct comparison with those in the files. A Los Angeles theater was dynamited and partially burned. A search of the premises resulted in discovery of a small open-mouth bottle, with a faint print of a right thumb on its side. With a file of right thumbs on his slanting searching-table, Lieutenant N. F. Hopkins compared the bottle print with those of known criminals. Within ten minutes he identified the suspected dynamiter, and two days later the fugitive was in custody.

Lone prints, impossible of identification only a few years ago, crop up in unsuspected places and prove the guilt of persons who otherwise would escape prison. They identify dead men lying on slabs in the morgues, save innocent men from the penitentiary and place the stamp of guilt on men who no living witness can identify.

The most dramatic case of which I learned is that of a young man who was freed after serving two years of a life term in San Quentin for burglary, robbery, and assault with intent to kill. A bandit, with his hat pulled far down over his face and his coat collar turned up, broke into a small home one evening. He uttered a single command to the woman: "Stick 'em up and give me your jewelry." When she attempted to escape he shot her in the back.

OFFICERS found a print on the inside of the screen frame, which he had jerked from the window. Although none of his prints corresponded with that on the screen, the woman identified a suspect by his voice and he was convicted.

Convinced of the youth's innocence, Captain Barlow periodically searched the files in an effort to find a duplicate of the print found on the screen. Then, as he was despairing of success, a batch of criminals' prints arrived from an Eastern city. Among them was a set from the fingers of Earl M. Carrol, alias "The Weasel." His right index finger matched the screen print! Carrol was extradited to California and convicted, James Preston was pardoned and released, and Carroll, identified by a two-year-old print, took the innocent man's cell in prison.

Again, a single print saved three men from possible prison terms, or hanging, in a murder case. A liquor dealer was killed and his wife seriously wounded as they lay asleep. His niece told officers she recognized one of three hijackers when he entered her room. The three men denied their guilt, but in view of earlier threats against the dead man, they were held in jail. Three days after the murder Captain Barlow searched the premises. On the right side of the barrel of the shotgun used by the killer he found an impression of the left index finger. It did not belong to any of the three suspects, nor to the deceased or his wife. As a matter of routine elimination, Barlow took prints of everyone who had access to the room. When comparing them with the print on the gun, he found it belonged to the niece. After sobbing a story of thwarted love she confessed and the three unhappy suspects were released.

An aged man arrived in Southern California one autumn day, planning to spend his declining years on the proceeds of his modest fortune. In a small park he met a fine-looking young chap who regaled him with stories of easy wealth. A few days later the chance acquaintance was enriched several hundred dollars by the sale of an enchanted money-making metal box. By the simple expedient of turning a crank, a dollar bill inserted at one end of the box emerged from the other as a twenty. After the machine changed hands, though, it refused to function.

THERE were no witnesses to the transaction. The old man could give only a meager description of the sharper. Here was a case that looked hopeless. Then the finger print experts got busy. They found several impressions on the polished metal surface. All belonged to the old man. Then, almost sliding off one edge, they obtained a faint print, one that did not match with any finger of the purchaser. Experienced searchers identified it as a right middle finger. They went to the proper file, extracted a handful of cards and found its mate, the print of a known confidence operator. Next day, detectives surprised him while working on another intended victim.

From many odd places the telltale ridges march into the files, sooner or later to trip up an unsuspecting criminal.

SIMPLE WAYS TO COLOR IRON AND STEEL

AS A VARIATION from the usual methods of finishing decorative metal parts, screws, hinges, and other fixtures, it is possible to apply simple plating or coloring solutions that protect against rust as well as add a distinctive appearance. The solutions are used with a brush, and special tanks or electrical outfits are unnecessary. The metal surfaces, of course must be clean and free from oil or grease.

A solution that will plate iron or steel with copper is made by dissolving in each ounce of distilled water the following chemicals: 50 grains of copper sulphate, 10 grains of iron chloride, and 10 drops of hydrochloric acid. After being plated by this method, the surface may be further changed in color. Rubbing the metal with sulphur, for example, will give a deep black (copper sulphide). A deep blue to blue-black, according to the length of treatment, may be obtained by dipping the coppered metal in a hot saturated solution of sodium hyposulphite (common "hypo") with three drops of hydrochloric acid added to each ounce. This is a good imitation of blued gun metal. If a saturated solution of potassium ferrocyanide is applied, the copper finish will be changed to a permanent red color that may be used in place of Chinese red enamel. When one or more drops of hydrochloric acid are added to the potassium ferrocyanide solution, the result will be a rich purple, the exact shade of which depends on the amount of acid used.

These solutions are mainly applicable to iron and steel treated with the copper solution. A black color may be obtained on other metals by using a solution of equal parts potassium chlorate and copper sulphate. Dissolve each chemical in distilled water and then mix the two thoroughly together.—GEORGE S. GREENE.

HOW COLLECTORS CLEAN OLD POSTAGE STAMPS

MANY postage stamps that come to a collector can be much improved in appearance by a little judicious cleaning. This also increases their potential value.

Heavy cancellations are the commonest disfigurement. They can be reduced by a gentle washing with soap and water applied with a soft paintbrush. It is, of course, a criminal offense to remove the cancellation completely, as well as being decidedly bad form among philatelists.

For spots and stains, chemicals have to be used, but care must be taken not to try anything that will change the color of the ink or paper. If possible, tests should be made on a damaged stamp of the same issue. Hot, or even boiling, water will often clean stamps effectively. If they are genuine and have not been repaired, they should stand boiling. Certain stamps are printed in soluble ink and these, of course, will not stand even cold water. Other stamps, but not many, are printed on a double paper, and the two paper layers will separate if the stamps are wetted.

Paint spots generally yield to turpentine. Buttermilk will ordinarily take off dark stains on the back of the stamps where the traces of gum have been attacked by mildew. A mild mixture of lemon juice and salt is recommended for rust and for ink stains. Carbon tetrachloride may be used instead of inflammable benzine for watermark detection. Hydrogen peroxide will restore the normal color to stamps that have become oxidized. Soak a stamp well in two or three baths of clear water after using any chemical treatment. Grease spots can generally be removed by means of a sheet of blotting paper and a hot iron.—DOUGLAS LEECHMAN.

HOME ANALYSIS OF EVERYDAY SUBSTANCES

(Continued from page 57)

solution. A confirmation of the caustic test will be obtained if the red solution now becomes water-white.

That mercurochrome contains mercury can be readily demonstrated by heating a small quantity of the red liquid with dilute sulphuric acid and then immersing a bright strip of copper in the solution. The mercury present will amalgamate with the copper.

AN IMPORTANT qualitative test, and one that every chemist should be familiar with, is known as Marsh's test for arsenic. This test consists of generating hydrogen gas in the presence of the material being tested. If arsenic is present, the hydrogen will combine with it to form arsenic hydride, or arsine gas, which when allowed to decompose under the right conditions forms telltale metallic arsenic.

The material to be tested, such as a tonic or horticultural insecticide suspected of containing arsenic, is placed in a flask along with some pure zinc. Dilute sulphuric acid is then added to the mixture. This produces hydrogen and arsine gas, if arsenic is present. The mixture of gases is then passed through a drying tube containing lumps of calcium or calcium chloride and finally through the tip of a glass medicine dropper.

Allow the gas to issue from the tip for several minutes. Then apply a match to the small jet and light the gas. Finally, hold a cold porcelain surface, such as the bottom of a laboratory evaporating dish cooled by holding a wet wad of cotton on the inside, so that it comes in contact with the tiny flame. If arsenic is present, it will be deposited on the porcelain as a shiny black coating.

Since antimony as well as arsenic might cause the formation of this black spot, a second and confirming test must be performed. This is done by pouring a fresh solution of bleaching powder over the spot. If it dissolves, the coating was metallic arsenic.

When performing the Marsh test for the first time, the home experimenter will gain experience by testing some compound already known to contain arsenic.

Another method of carrying through the arsenic test consists of passing the gasses issuing from the generator first over lead-acetate paper and finally over strips of paper which have been soaked in mercuric chloride solution and allowed to dry. Used in place of the calcium chloride in the drying tube, the lead acetate paper removes any impurities in the form of hydrogen sulphide from the gases before they are exposed to the test papers. If the mercuric chloride papers turn brown, arsenic is present. This is known professionally as the Gutzeit's arsenic test.

Since both tests are extremely delicate, it is important that only chemically pure zinc be used in the preparation of the hydrogen. However, since pure zinc is not readily acted upon by acids, a small particle of copper, or better still a drop of copper sulphate solution, should be added to hasten the reaction.

THE secret of baking powder is its ability to give off carbon dioxide which in turn makes the dough rise. The amateur chemist can perform an interesting experiment by testing the gas-generating quality of the brand used in his kitchen. Using a small quantity of the powder—a level teaspoonful will be sufficient—in a flask and adding water, the liberation of the carbon dioxide can be watched and the quantity measured through the use of some collecting device. For this, a pneumatic trough, such as recently described (P. S. M., June '33, p. 48), can be used, the gas being measured by holding a scale along the edge of the *(Continued on page 127)*

HOME ANALYSIS OF EVERYDAY SUBSTANCES

(Continued from page 126)

collecting bottle. By a simple calculation, the entire volume of gas can be gaged.

Baking powder is composed of one of several acidlike compounds, bicarbonate of soda, and starch. The starch is added to the mixture, not as an adulterant, but as a means of preventing the granules of active ingredients from abstracting moisture from the air. The starch coats the granules and blankets out the moisture, thus preserving the strength of the powder.

IF HE desires, the experimenter can test for the presence of starch in baking powder or any other starch-containing substance such as potato, pudding powder, or bananas. Shake a bit of the substance being tested in a test tube of water and add a drop of iodine. If the characteristic blue color of the starch test appears, starch is present.

By following the list of ingredients given on the baking-powder box, the amateur can perform many other interesting tests. For instance, if it is a phosphate powder, the presence of combined phosphorous can be detected by heating a small quantity of the powder with five or ten cubic centimeters of weak nitric acid and filtering the solution. If a yellow precipitate is formed when several drops of ammonium molybdate solution are added to the filtrate, it indicates phosphorous.

Similarly, aluminum can be detected by adding ammonium hydroxide to a fresh batch of the acid filtrate. This will produce a white jellylike precipitate of aluminum hydroxide if aluminum forms a part of the original powder.

Tartaric acid likewise can be identified by shaking a quarter teaspoonful of the baking powder with water and filtering. To about ten cubic centimeters of the filtrate add several drops of ammonium hydroxide and again shake. Finally add several tiny crystals of silver nitrate and, without shaking or disturbing the container, place it for several minutes in water heated to about seventy degrees Centigrade. The presence of a tartrate will be indicated by a gray, almost black, precipitate of metallic silver. Often, the free silver will coat the inside of the test tube to form a mirror-like surface. If it does not, it indicates that the presence of sodium (or calcium) phosphate has prevented the formation.

Although in most of these tests we have confined our discussion to specific materials, they are by no means limited to these uses. The starch test, for instance, can be used to test almost any substance for starch, the iodine test for any iodine compound, and the phosphorous test for any material containing phosphorous. Try them on any of the liquids or solids in your medicine cabinet. You will be surprised at what you will find.

ELEMENT RARER THAN RADIUM IS ISOLATED

PROTACTINIUM, a radioactive metallic element rarer than radium, has at last been isolated in its pure form by Dr. Aristid von Grosse, young research associate in a Chicago oil company laboratory. The element, known as number ninety-one, is obtained from pitchblende and gives off emanations identical with those discharged by radium. It is so rare that only one part is contained among 10,000,000 parts of pitchblende. Protactinium disintegrates into actinium, known as element number eighty-nine, which is said to be more than 140 times more active than radium. Both protactinium and actinium are expected to be as useful as radium in the treatment of cancer. Protactinium may be obtained at a lower cost than radium.

FIRE AT SEA CHALLENGES SCIENCE

(Continued from page 17)

bridge can see it from almost any position.

During the six years from 1925 to 1931, there were 1,091 fires on American-owned merchant vessels. The total loss was $37,369,547. According to the best available figures, there were an average of 536 fires a year on ocean vessels during the half decade from 1920 to 1925. Of this total, seventy-one per cent, or nearly three out of four, started in cargo holds and storerooms. Universal use of automatic gas equipment promises to go far in eliminating such fires.

BUT not all marine fires begin in the hold. Those that start in the upper part of the ship, and especially in public rooms, demand different treatment. To combat them, a score of innovations are proposed. One inventor has brought out a door hold-back with fusible links. In case of fire, these links melt first and let the doors swing shut, thus cutting off air currents that would fan the fire. Thermostatic alarm systems, which go off when the temperature in a stateroom rises above the danger point, are being designed for ship use. Connected with fire headquarters on the bridge, such systems would automatically sound a gong and flash on a red light to indicate the point where the fire is starting.

Light-weight automatic sprinkler systems, such as are installed in public buildings, are under construction for ocean craft as well. Moldings, wardrobes, beds, wastebaskets, all of fireproof metal but grained to match the wood effects of the room, are available for use on ocean liners. Stateroom partitions and doors are being designed with hollow metal cores or with sheets of steel laminated on asbestos or composition cores. Where a wood-paneled effect is required, coatings of veneer, one hundredth of an inch thick, are placed over cores of fireproof construction. Such innovations form valuable advances in eliminating the fire hazard from ships.

In the past, the fact that the public seemed to favor vessels built and furnished like hotels, with high ceilings, wood panels, draperies, wooden furniture, rugs and upholstery, all inflammable, has hindered the construction of completely fireproof ships. Now, with travelers demanding safety, vessels which will be practically immune to fire are likely to make their appearance.

One school of naval architects maintains that the substitution of steel for wood in staterooms and public places will make the ship top-heavy. Another school contends it can be done with perfect safety by making a few slight alterations in the vessel's design.

In New York City, George G. Sharp, noted naval architect and a member of the Marine Committee of the National Fire Protection Association, has worked out designs for a fireproof ship which will cost little more than a similar ship of ordinary design. By an ingenious arrangement of staterooms and by high efficiency in construction methods, he cuts out much of the traditional waste. This money he spends on fireproof bulkheads, doors, partitions, and furniture.

IN THE ordinary vessel, bulkheads rise from the bottom to the first, or bulkhead, deck. In Sharp's design, they will continue clear to the upper deck, forming fireproof walls at intervals of 130 feet or less, dividing the ship into compartments within which fires can be fought without danger of their spreading. Special doors, leading through the bulkheads, will be formed by heavy metal shells filled with fire-resisting, non-conducting material. They can be opened or closed, in an emergency, from the bridge.

All vertical shafts, such as those needed for elevators, hatchways, ventilators and stairways, will be enclosed by insulated steel partitions. In order to reduce the openings in the bulkheads to a minimum, the ventilating system will be laid out in units, the electric fans and other equipment being fully contained within each bulkhead-enclosed space. All ventilator motors can be shut down at once from two points remote from each other on the ship. Thus, the officers can cut off drafts within a section even if they are unable to enter it.

THE other day, when the new Cunard-White Star liner, the *Queen Mary*, slid down the ways into the water at Clydebank, Scotland, it carried provisions for an elaborate system of protection against fire. Smoke tubes and an immense battery of carbon-dioxide tanks will ride in its giant hull when it takes to the sea on its maiden voyage. In addition, there are special Diesel-driven lifeboats swung on electrically operated davits of new design. At the touch of a lever, an operator can lower one of these boats fully loaded into the water in the space of a few seconds.

Larger than the American giant, the *Leviathan*, the new vessel is 1,018 feet long. It was built at a cost of $30,000,000. The rudder alone weighs 280,000 pounds, more than the combined weight of Christopher Columbus' vessels the *Santa Maria* and the *Nina*. A special door in the side of the rudder enables inspectors to enter and examine the interior. With such floating cities coming from the shipyards, fire protection at sea is of ever-increasing importance.

The wreck of the *Republic*, in January 1909, led to the compulsory installation of ship radios. The *Titanic* disaster, in April 1912, brought about the establishment of the International Ice Patrol. And, undoubtedly, the *Morro Castle* tragedy will lead to compulsory adoption of scientific equipment for preventing and fighting fires. The price of safety at sea is eternal vigilance—vigilance and the quick adoption of all the aids which science can offer.

FIRES CAUSED BY BIRDS USING CIGARETTE BUTTS

BIRDS sometimes cause fires, it is reported by the Railway Fire Protection Association, by picking up lighted cigarettes and dropping them upon the roofs of buildings. When an abandoned theater was destroyed not long ago in Rockwood, Tenn., spectators reported having seen sparrows, which had nests in the building, pick up lighted cigarettes and fly off with them still burning. In Knoxville, Tenn., a railroad engineman is reported by the fire chief as having seen a bird drop a burning cigarette on the eaves of a house. When he next returned to the city the engineer was surprised to see that the structure had been destroyed by fire.

MARTINIQUE ISLAND HAS VOLCANO MUSEUM

A UNIQUE volcano museum was recently opened at St. Pierre, on the West Indian island of Martinique. It was here that an eruption of Mt. Pelee in 1902 killed 30,000 inhabitants of the town almost instantly. The single survivor found by rescue parties was a prisoner held in an underground dungeon. The museum will contain relics dug from ruins of eruptions of Mt. Pelee and other famous volcanoes. The institution was founded by Frank A. Perret, an American scientist who has conducted researches at Mt. Vesuvius, in Italy, and Mt. Sakurajima, in Japan.

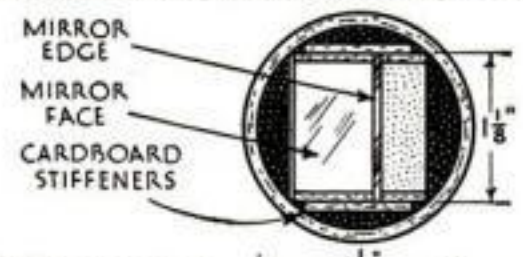
SIMPLE "SKY GLOBE" POINTS OUT STARS

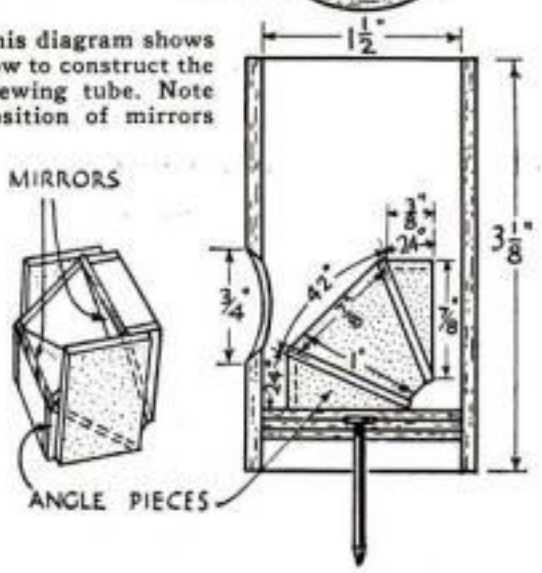
(Continued from page 43)

indicates the line labeled 40, between the dates February 1 and February 15. The upper half of the globe then indicates the principal stars visible at 9:40 P.M. on February 1 or at 9 P.M. on February 10.

In the same way, when observing at 8 P.M., the pointer should indicate a date two weeks earlier in the year. A few moments spent in turning the globe back and forth will make its use plainer than a great deal of explanation.

The essential feature of the sky globe which enables it to point out the principal stars is that their positions on the globe are the same, in miniature, as the positions of the actual heavenly bodies in the sky. In other words, if you imagine straight lines drawn outward from the globe's center through the stars' positions indicated upon it, these lines, prolonged





infinitely, would pass through the stars in the sky when the correct date is under the pointer.

Since this is so, all we need is something to indicate these lines accurately. This is the purpose of the viewing tube.

The viewing tube is simply a short length of mailing tube provided with a base containing a projecting stud in its center. This stud fits into any one of the holes punched in the globe's surface through the various star positions. In addition, the viewing tube is provided with two small bits of mirror placed in the tube in such a way that when the rays from a star or star group enter the end of the tube they are reflected at right angles out of the side to the observer's eye.

You may wonder why a single mirror set at forty-five degrees in the tube would not do for this purpose. A single mirror would do equally well for single stars, but it would reverse the appearance of every constellation, just as a single mirror reverses the lettering on a store window. Accordingly, the viewing tube should have two mirrors. This arrangement corrects the reversal of one mirror by another, and shows the star groups just as they appear in the sky.

In addition, the miniature maps of the star groups, in which principal stars appear, are drawn as they appear in the sky. Even a person entirely unfamiliar with a constellation can recognize it when the globe points it out through the viewing tube. He has only to compare its star arrangement with the miniature map drawn within the circle covered by the base of the viewing tube.

The small rectangular mirrors for the viewing tube are easily cut with a ten-cent wheel cutter, and the *(Continued on page 130)*

SIMPLE "SKY GLOBE" POINTS OUT STARS

(Continued from page 129)

mirror chassis glued together from the various pieces of cardboard, cut accurately to the correct size. When the mirror chassis is dry, it is slid down upon the bottom of the tube and glued in place with the mirrors facing the side opening.

To set up the sky globe on a table or flat-topped tripod proceed as follows:

First, make sure that the semicircular scale is set with the proper latitude figure showing through the notch. Then point the axis approximately toward the polestar. Put the viewing tube in position in line with the globe's axis. Slip the stud on the base of the viewing tube into the empty hole above the upper end of the globe's axis. Then look into the side opening of the viewing tube and you should see the polestar in the center of the mirror. If you do not, shift the direction of the globe's axis until you do see the polestar at the center of the field. This done, turn the viewing tube in its socket through a quarter turn and look for the polestar again. It should be in the center of the field when looking into the side opening, no matter which way the viewing tube is turned.

When this condition is met, you are ready to set the proper date under the pointer and transfer the viewing tube to other positions. In each case you will see the star you are looking for when you place the stud of the viewing tube in the proper hole and look through the side opening into the mirror.

Look on the globe for the name of the star you want to find. Turn up the proper date and hour. Set the viewing tube over the proper circle. Look into the mirror, and there's your star with its star group shown just as it is in the sky and just the way you see it on star maps.

FIND RELICS OF ARCTIC EXPLORER LOST IN 1597

RELICS dating back 337 years to the last expedition of Villem Barents, the Dutch explorer who is known as the "Columbus of the Arctic," have just been uncovered on Nova Zembla by Russian scientists. Barents, discoverer of Spitzbergen and the Barents Sea, made three pioneer journeys into the north, opening it up to European explorers. His last trip in 1597 was an attempt to discover a northeast passage to the Orient. At Nova Zembla, his ships were wrecked and Barents was later killed in an attempt to reach the mainland in a makeshift craft. In 1871, Norwegian explorers found the site of the Nova Zembla camp and later part of Barents' journal was discovered. Additional relics of this ill-fated pioneer expedition have now been uncovered by a Russian group under the leadership of Boris Miloradovich, twenty-six years old and the youngest man ever to head an Arctic expedition from Russia.

SUGGEST GUNNING WITH CANNON FOR SKY FACTS

BIG Bertha guns, such as bombarded Paris during the World War, could be used to wrest long sought secrets from the mysterious upper regions of the air, U. S. Weather Bureau experts believe. Projectiles would be hurled twenty-four miles into the air by the huge guns. They would carry devices for bringing back to earth samples of air and indications of how the winds blow at extreme elevations. In addition, new light would be shed on the layer of ozone that is supposed to exist between twenty-two and thirty-seven miles above the earth and the composition of gases forming the stratosphere would be revealed, the weather men contend.

GUS TELLS WHAT TO DO IF YOUR STARTER BALKS

(Continued from page 64)

is closed and the threaded shaft turns, but the weighted gear tends to stand still. That screws the gear out on the shaft where it finally meshes with the flywheel teeth and turns the motor.

"Naturally, as soon as the engine starts firing under its own power, the flywheel goes faster than the starter motor spindle. That screws the starter gear backwards on the shaft, disengages the teeth, and lets the flywheel run free."

"But what's this spring for?" asked Dave, pointing to a heavy coil half hidden by the starter motor housing.

"That's a sort of shock absorber," explained Gus. "Takes up the sudden jerks when the two gears mesh. Now, to get back to your trouble, for some reason or other, the counterweighted gear on this drive got jammed in the flywheel teeth. It wouldn't release, and it wouldn't let the starter motor turn the flywheel."

"Well, how did rocking the car loosen it?"

"THAT'S simple," Gus said. "With the gears in high, the flywheel jiggled back and forth every time we rocked the car. Gradually, it moved enough to ease the pressure and the counterweighted gear turned back out of the way."

"Maybe that thread on the shaft needs a little oil," suggested Dave.

Gus shook his head. "Not on your life! An automatic drive on a starter motor is one part on a car that works best without oil. That counterweighted gear should screw out easily, but not too easily. If you use light oil, the gear will slip out on the thread. Heavy oil will gum in time and keep the gear from screwing out at all. Nope, it's never lack of oil that makes a starter drive stick."

"Well, then, what does?" questioned Dave.

"Oh, lots of things. Wear, mostly. Sometimes the shaft gets bent and binds and sometimes a broken tooth on the flywheel causes the jam. The trouble generally starts when somebody steps on the starter when the motor's running.

"It's something else in your case, though," he said. "See the deep nick at the end of that tooth? That's probably what made it stick this morning. Better drop down when you have the time and let me put in a new one. For the time being, I'll leave it alone so you can use the car."

"But suppose it jams again?" protested Dave.

"Then just put her in high and rock her," advised Gus. "If that doesn't loosen her up, unscrew the top mounting stud a bit and rock her some more. It may not happen again for several days, or even weeks. It all depends on the positions of the starter gear and the flywheel."

"SAY, Gus, a while back you said that some cars didn't have starters like this. What kind do they have?"

"Manually operated drive gears," replied Gus. "The same pedal that closes the starter-motor switch pushes the starter gear into mesh with the flywheel. Then when you let up on the pedal, a spring pushes it out of mesh."

"Well, live and learn," sighed Morrison. "This is the first time I've ever had trouble with a starter, but I think I'll know what to do if it happens again."

"Starters are almost fool-proof these days," said Gus. "There aren't many troubles you can have and when they do crop up, they're easy to recognize."

"For instance?"

"Well," Gus pondered, "that shock-absorbing spring you (Continued on page 131)

GUS TELLS WHAT TO DO IF YOUR STARTER BALKS

(Continued from page 130)

saw can break, but you'll know it as soon as it happens. When you step on the starter, you'll hear the starter spin, but it won't turn the engine. A gummy or dirty shaft on the starter will produce the same result.

"If the starter doesn't run at all when you push the button, it's a good sign there's a break in the wiring, either inside the motor, at the switch, or in some of the connections. Of course, that's taking for granted that the battery isn't dead.

"Sometimes, you come across a case where the starter motor turns, but only cranks the engine slowly. That's generally caused by weak brush springs, an open field or armature winding, or a dirty commutator."

"BY the way, Gus," put in Morrison, "now that winter's about here, is there anything I can do to put that starter in shape for cold weather?"

"Starters don't need much attention," said Gus. "Outside of the gasoline bath I'll give the starter shaft to clean it when you bring the car in for that new gear, all the care it'll need will be a few drops of good motor oil every five hundred miles or so.

"About the best insurance against hard winter starting," added Gus, as he climbed aboard the wrecker, "is a top-notch battery and a generator that's been adjusted to make up for all the juice used turning over a cold engine. Check up there when you put anti-freeze in your radiator and light oil in your crankcase."

AVERAGE AUTO SPEED IS THIRTY-FIVE AN HOUR

IF YOU are an average motorist, you cruise at thirty-five miles an hour. That is the conclusion of recent tests reported by Prof. A. N. Johnson, of the University of Maryland. Forty-one thousand vehicles were timed traveling along the Maryland highways by a special speed detector developed for the purpose. One per cent of the vehicles were found to be going more than fifty-five miles an hour; twelve per cent between forty-five and fifty-five; forty-three per cent between thirty-five and forty-five; thirty-six per cent between twenty-five and thirty-five and eight per cent between fifteen and twenty-five. The overwhelming majority of the cars were traveling in the neighborhood of thirty-five miles an hour, which is accepted by the Highway Research Board of the state as the present average on the highways. The tests are expected to provide data that will be valuable in highway planning and accident prevention work.

FLIGHT OF WATERFOWL BAFFLES EXPERTS

THREE sea birds which broke the distance record for homing pigeons were recently studied by experts of the Carnegie Institution, of Washington, D. C. Taken from their nesting grounds in Florida, the three terns were put through tests to determine their reaction to various stimuli. Then, after being banded, they were released from a ship off Cape Hatteras, 1,081 miles to the north. Five days later, they were seen back at the nesting place on Bird Key. The record for pigeons is 1,010 miles. In their tests, the scientists were not able to discover any special sensitiveness on the part of the birds to sound, smell, light or other stimuli, which might account for their feat. Their marvelous ability to span long stretches of sea and land as though following a compass is classed as an instinct and still baffles science.

Earth's Last Drop of Oil To Be Recovered

(Continued from page 31)

this herculean task be accomplished?

By fewer and larger wells, by applying back pressure to the wells, by repressuring, by driving oil up one well as gas is forced down another, by mining for oil much as one digs gold and silver from the earth.

Experiments undertaken by Uren and Prof. A. J. Carlson of the University of California have led to some interesting discoveries. The California scientists are studying each of the retentive forces separately in an effort to determine the effect of each and to learn how it influences the flow from a field. They measure the permeability of various kinds of sands, determine the interfacial, or surface, tension between oil and water with a delicate tensiometer, even measure the porosity, or void space between the sand grains, to learn exactly how much oil a given stratum will contain under known pressure.

HERE they place a small quantity of oil-saturated sand in one end of the porosimeter, tilt the instrument and read the total volume on two tubes. Now they remove the sample, dry it thoroughly, grind the sand to tiny pieces and again measure the new volume. The difference between the first and second readings indicates the original amount of open space.

But the studies do not stop here. Uren has gone into the fields to study conditions of production and then returned to his miniature oil field and conical tube and there he has submitted the questions to these remarkable machines.

The miniature field, for instance, reveals that larger wells have both a larger initial and greater ultimate recovery. The conical tube shows that in the larger wells the gas pressure is more evenly distributed through the sand. From these results Uren concludes that half the number of wells now sunk can be made to produce more oil than present wells at half the cost.

They show, also, that more oil can be taken from a well if it is not permitted to flow at full capacity. Back-pressuring by restricting the flow increases the ultimate recovery as much as half.

"By varying the back pressure on the conical tube and measuring the pressure at different distances from the wall of the well, represented by one end of the tube, it is found that we can alter the form of the pressure gradient and obtain through the reservoir rock a more equal distribution of the energy that forces oil outward," Uren explained.

The conical tube has yielded other interesting information. While it represents the flow through one square inch on the wall of a normal well, Uren has found that from it he not only can predict very definitely what goes on during drainage but also can determine the radius from which one well would draw its supply.

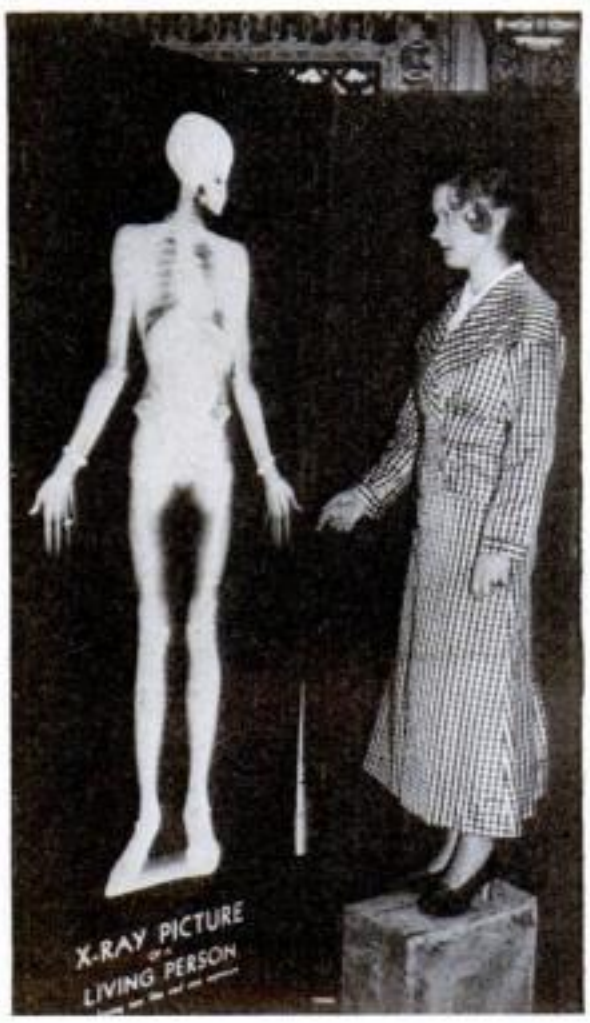
"We seek," he told me, "some means of controlling both the rate of flow and the expansion of gas. Back-pressuring is one influence. With the tube we get right down into the oil sand, study the pressure gradient and obtain primary data. You can appreciate the importance of this when you realize that half the pressure is lost within five feet of the wall of an ordinary well. Our problem is to distribute this pressure loss over as wide an area as possible. By holding back on the flow, we are able to get more uniform expansion of gas, which means that we use only enough gas to bring the oil into the well, saving the rest as a driving force for later use."

That is the reason Uren advocates fewer and larger wells. Here are the results of two experiments conducted in the miniature field which support his conclusion:

A three-inch well two minutes after it was brought in was flowing at the rate of 17,000 cubic centimeters a minute, and forty-eight minutes later was producing 200 c.c. a minute. A one-inch well was producing 5,200 and 100 at the same intervals of time. The total production was equivalent to several months' production of full-sized wells in the field.

Again, two baby wells, in size three inches and one inch respectively, produced totals of 70,080 and 35,725 cubic centimeters of oil.

In some of the older American fields, efforts have been made to restore the pressure of exhausted oil sands by bringing natural gas from new fields and forcing it down old wells. Experiments with the miniature field indicate that old wells may be repressured many times, each repressuring resulting in the recovery of additional quantities of oil. This method alone has yielded as much as half the total quantity available, or two and a half times that which flows by pressure and pumping.



X-Ray Pictures Now Made Full Length

Modern x-ray technique makes it possible to take a full-length x-ray picture with a single exposure and on a single film. In the picture above, the subject's wrist watch, bracelet, and shoes can be seen.

AMERICA'S future oil supply, Uren says, will probably be derived by mining. Though more expensive than production through wells, the mining method offers greater possibilities for recovering oil from the vast underground treasure chambers than do any others.

Here oil miners sink shafts and drive drifts, either directly into oil-bearing rock or above and below the strata to be tapped, and drain the oil through mine openings. Unlike mining for metals, the sand is not removed. Already two such mines are being operated, one in Alsace and the other near Hanover, Germany. One of these mines, in the Pechelbronn field, is among the world's largest mining enterprises.

One large American company has been seeking means, not only for reviving oil fields by this method, but also of tapping new sources. Fields not yet drilled are being staked out for exploitation when rising prices and a depleted national supply make the method economically feasible.

MINING for oil has been proved a success in the Pechelbronn fields. During the war the wells there became practically exhausted. Germany, then in control of Alsace, decided to bring up the remaining oil through a vast system of mine shafts and galleries. Today ninety miles of these galleries have been built in that project. Since the war, France has continued to extend these mines until the secondary recovery of oil has amounted, in some areas, to three times that which originally flowed up through the wells.

"This method," said Uren, "has great possibilities for the United States in the lean years to come. Oil mining will become a large industry when there no longer are flush fields to exploit. Oil will become more expensive, but there will be oil."

He has studied mining methods in Europe and surveyed several hundred American fields to determine where they may be applied. Most practical operations, he finds, can be conducted in the upper 2,000 feet of the earth's surface. Beyond that depth the expense mounts and at great depths the heat rises too high for ordinary mining methods.

As men tunnel into the earth for oil, much of the mystery surrounding its occurrence disappears. In the European fields, exploited in the upper 800 feet, the operators find oil in large lenses, some as wide as seventy-five feet and 1,000 feet long. Although very tough when in place, the sand, when removed, may be broken easily by the fingers. In one part of the Pechelbronn field, four wells sunk into these lenses produced 147,000 barrels. In the following three years, 338,800 barrels were taken from the same area by mining. Here the operators drive shafts directly into the oil-bearing sand, cut it up by drifts and shafts into blocks 160 feet square and drain off the oil on all four sides.

Oil mining has already been found practicable by older methods in the United States. Several years ago the Union Oil Company of California drew oil from Sulphur Mountain, near Ventura, through thirty-one tunnels. Near Newport Beach, Calif., J. Sharkey sunk a shaft at an angle of forty-five degrees and drew oil from the sand after heating the nearby rock with steam coils, thus making the oil less viscous so that it flows more freely. At Ravenna, Ky., a shaft was sunk 130 feet and some oil obtained.

Exactly how much oil will be removed from a given field through mining cannot always be foretold accurately, though it sometimes may be forecast from the amount of gas which escapes from the wells. Knowing the pressure existing in the oil reservoir, petroleum engineers can determine how much oil is required to hold a given amount of gas in solution. A barrel of oil under high pressure may contain 1,000 cubic feet of natural gas, or more, the amount depending upon the pressure.

Seemingly unrelated studies, these. But, added together, they present a remarkable picture of the mysterious processes that have been going on under the earth through countless centuries and show how man may yet draw the last drop of oil from these hidden pressure chambers.

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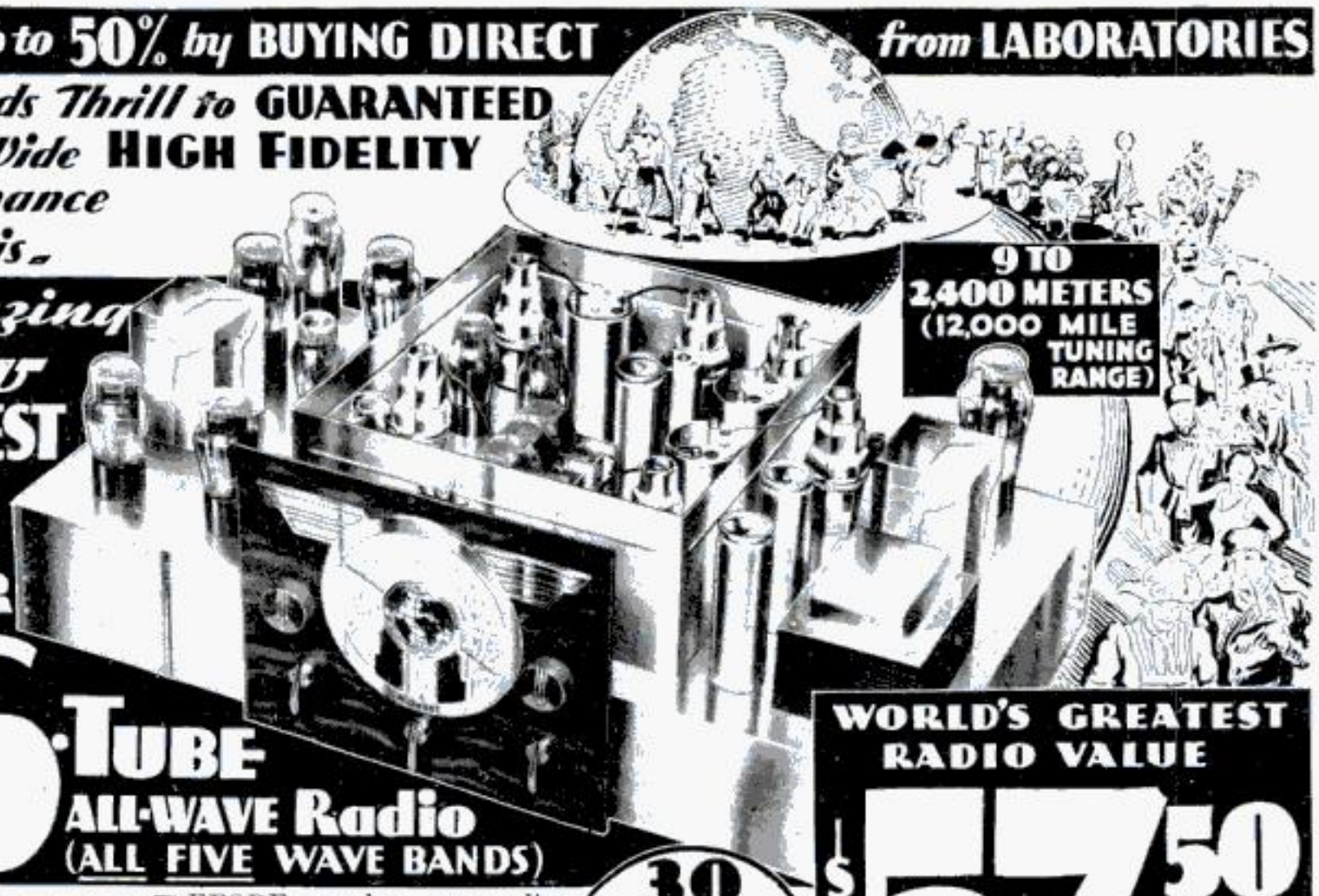

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